VOL. 76, No. 1 SEPTEMBER, 1941

IMPERIAL MYCOLOGICAL INSTITUTE
26 JAN 1942

THE PHILIPPINE JOURNAL OF SCIENCE

MANILA
BUREAU OF PRINTING
1941

58000

DEPARTMENT OF AGRICULTURE AND COMMERCE

RAFAEL R. ALUNAN, *Secretary*

JOSÉ S. CAMUS, *Under Secretary*

THE PHILIPPINE JOURNAL OF SCIENCE

Published by the Bureau of Science, Department of Agriculture and Commerce

[Entered at the Post Office at Manila, Philippines, as second-class matter.]

A. S. ARGÜELLES, D.Sc., *Editor*
EDUARDO QUISUMBING, PH.D., *Associate Editor*
EDUARDO R. ALVARADO, A.B., LL.B., *Managing Editor*
SOPHIE RODOLFO, M.A., *Copy Editor*

Chemistry

MANUEL L. ROXAS, PH.D.; A. P. WEST, PH.D.; T. DAR JUAN, PHAR.D.
JOAQUIN MARAÑON, D.SC.; PATROCINIO VALENZUELA, PH.D.
MARCOS M. ALICANTE, PH.D.; F. T. ADRIANO, PH.D.; R. H. AGUILAR, CH.E.
A. J. HERMANO, D.SC.; V. G. LAVA, PH.D.; J. C. ESPINOSA, B.S.
MARIA Y. OROSA, M.S.

Geology

Q. A. ABADILLA, E.M.; V. ELICAÑO, B.S.; JOSÉ M. FELICIANO, PH.D.
ANTONIO D. ALVIR, PH.D.

Experimental Medicine

DANIEL DE LA PAZ, M.D.; H. W. WADE, M.D.; ARTURO GARCIA, M.D.
ONOFRE GARCIA, M.D.; CRISTOBAL MANALANG, M.D.
ISABELO CONCEPCION, M.D.; VICTOR BUENCAMINO, D.V.M.

Clinical Medicine

ANTONIO SISON, M.D.; LIBORIO GOMEZ, M.D., PH.D.
JOSÉ ALBERT, M.D.; H. LARA, M.D.
JOSÉ RODRIGUEZ, M.D.; CARMELO REYES, M.D.

Botany

ELMER D. MERRILL, D.SC.; E. B. COPELAND, PH.D.
A. F. FISCHER, C.E., M.F.; T. G. FAJARDO, PH.D.
RAFAEL B. ESPINO, PH.D.; NICANOR G. TEODORO, PH.D.
JOSÉ B. JULIANO, PH.D.; FELICIANO M. CLARA, PH.D.
J. K. SANTOS, PH.D.

Zoölogy

HILARIO A. ROXAS, PH.D.; MARCOS A. TUBANGUI, D.V.M.
LEOPOLDO B. UICHANCO, D.SC.; HERACLIO R. MONTALBAN, M.A.
GONZALO MERINO, PH.D.; FAUSTINO Q. OTANES, M.S.
MANUEL D. SUMULONG, M.S., D.V.M.; LOPE M. YUTUC, D.V.M.
DEOGRACIAS VILLADOLID, PH.D.; CANUTO G. MANUEL, D.SC.

Anthropology

H. O. BEYER, M.A.; RICARDO E. GALANG, M.A.

THE PHILIPPINE JOURNAL OF SCIENCE

VOL. 76 SEPTEMBER, 1941 No. 1

THE INFLUENCE OF HYDROGEN-ION CONCENTRATION ON THE FIXATION OF SOME PHILIPPINE VEGETABLE TANNING EXTRACTS BY HIDE POWDER

By LEON G. ALEJO, LUZ BAENS, and V. G. LAVA

Of the Bureau of Science, Manila

THREE TEXT FIGURES

In a previous article we reported the diffusion characteristics of some Philippine vegetable tanning extracts which have possible commercial value.(2)

Vegetable tanning is the process of rendering raw animal skin nonputrescible by bringing it in contact with the aqueous extract of parts of plants that contain tannins. The degree of tannage is essentially the result of two factors, the rate of diffusion of the tannins into the skin and the rate of fixation of tannins by the skin protein. Evidently the tanning process is not complete unless the tannins have fully penetrated the skin, but the character of the leather is markedly influenced by the degree and uniformity of fixation by tannins throughout the skin.

Fixation is the chemical or physicochemical combination of the hide substance with the tannins which diffuse through its fibers.

The studies recorded in this paper were undertaken to determine the fixation characteristics of the vegetable tanning materials which were previously employed in our diffusion experiments. The fixation experiments were carried out under different pH conditions. A study of both the diffusion and fix-

ation characteristics of tanning materials is of basic importance to the tanner.

EXPERIMENTAL PROCEDURE

Extracts from the following Philippine vegetable tanning materials were used: Anabiong [*Trema orientalis* (Linn.) Blume], bakauan (*Rhizophora candelaria* DC), betel nut (*Areca catechu* Linn.), bitaog (*Calophyllum inophyllum* Linn.), kalumpit (*Terminalia edulis* Blanco), kamachile [*Pithecolobium dulce* (Roxb.) Benth.], and Philippine black wattle (*Acacia decurrens* Willd.). For comparison, imported extracts of quebracho (*Quebrachia Lorzentzii* (Griseb.), myrobalan (*Terminalia cebula* Retz.), and black wattle were also used. The analyses of these extracts have been given in the article cited above.

The hide powder used in this investigation was made by the Standard Manufacturing Company, Ridgway, Pennsylvania. It was first passed through a 100-mesh sieve to remove the fine dust that would be lost in the subsequent filtration through linen bags.

The powder was then thoroughly extracted with chloroform to remove the fat, and finally air-dried. The moisture in this stock sample was determined by drying the powder in a vacuum oven at 100°C. for 5 hours. All weights of the hide powder are reported on this moisture-free basis.

The general principle of the Wilson-Kern(11) method for tannin determination was employed for our fixation experiments. This method is based on the definition of tanning material as that portion of water-soluble matter in vegetable substances which precipitates gelatin from solution, and also forms with hide substance compounds resistant to washing with water.

The older methods for the determination of the tannin content of an extract consist in measuring the change in concentration of the tanning liquor before and after shaking with hide powder. These methods are subject to large errors due to the well-established fact that the hide powder removes not only tannins but also some nontannins from tanning solutions. This error is avoided in the Wilson-Kern method because the nontannins, which do not combine with the hide substance, are removed in washing the fixed hide powder. Furthermore, the tannin content of an extract, as determined by the older methods, varies with the acidity of the solutions, as shown by Thompson,

Seshachalam, and Hassan.(9) However, with the Wilson-Kern method the pH value appears to have no effect upon the determination of tannin content over the range of 3.6 to 7.3.(12)

Our experimental procedure for tannin fixation was a modification of the Wilson-Kern method and also of the process of Thomas and Kelly.(6) It consisted in measuring the increase in weight of a hide powder sample after fixation, thorough washing and drying. An excess of tanning material was necessary to make sure that all of the hide powder was fixed by the tannin.

In all the experiments, 2-gram samples (dry basis) of the specially prepared hide powder were placed in wide-mouthed 300-cc bottles. To these were added 100-cc portions of tanning solutions (about 2 per cent total solids) having different pH values.

Adjustment of the solutions to the desired hydrogen-ion concentration was made previously by the addition of calculated amounts of either 0.1 N H_2SO_4 or 0.1 N NaOH. After the addition of acid or alkali the solutions were set aside for at least 24 hours before the pH values were determined with a glass electrode type of pH meter.

The tightly covered bottles were shaken mechanically for 24 hours at room temperature (20° to 30°C.). The tanned hide powder was filtered in linen bags and washed with distilled water. Washing was continued for at least 4 hours, at decantation intervals of 20 minutes, until the wash water was free from tannins as detected by the gelatin salt reagent. Thomas and Frieden (5) claim that this test has a delicacy of 1 part tannin in 100,000 parts of solution.

The fixed hide powder was transferred to a weighed Gooch crucible matted with asbestos. It was then air dried for a day or so to remove most of the water. Next it was heated in a drying oven at 70°C. for 5 hours and finally the last traces of moisture were removed by heating in a vacuum oven at 100°C. for about 5 hours. The increase in weight (dry basis) of the hide powder represented the amount of tannins fixed by the hide powder.

Thomas and Kelly(6) showed that hydrolysis of hides occurring at the extremes of pH 1.0 and 11.0 may be disregarded when tannage is accomplished in short periods. The same workers also showed that washing the fixed hide powder with buffer

solution having a pH identical with that of the tanning solution used gives slightly different results from those of hide powder washed with distilled water alone.

Longer periods of washing were also tried, and although the fixed hide powder suffered no decomposition as tested by Stiasny's method,(4) the results showed no decided advantage over the shorter periods of washing.

DISCUSSION OF RESULTS

Tables 1 to 10 show the degree of fixation of the tannins of different extracts by hide powder at different pH values after 24 hours of contact. These figures are indicated graphically in text figs. 1 to 3.

TABLE 1.—*Fixation of anabiong tanning extract by hide powder.*

pH of tanning solution.	Tannin fixed by 2 grams of hide powder in 24 hours.	Fixation.
	g.	*Per cent.*
1.00	1.249	66.4
1.50	1.010	53.7
1.90	0.973	51.8
2.50	1.261	67.0
3.00	1.113	59.2
3.40	1.135	60.4
4.00	1.079	57.4
4.50	1.021	54.3
5.00	0.974	51.8
5.50	0.792	42.1
5.75	0.810	43.1
6.00	1.086	57.8
6.50	0.994	52.9
7.00	0.956	50.9
7.50	1.175	62.5
8.10	1.443	76.8
8.50	1.179	62.7
9.00	0.978	52.0
9.50	0.926	49.3

NOTE.—The anabiong tanning extract contained 1.88 per cent of total solids.

Text figs. 1 to 3 show that the different tanning extracts studied have characteristic rates of fixation at different pH values. In all of the experiments there was a maximum fixation at pH 2.0 to 3.0 and a minimum at around pH 5.0 on the acid side. On the alkaline side the tanning extracts had another maximum fixation at pH 7.0 to 8.0. When the pH was higher than 9.0 there was a drop in the fixation curves.

TABLE 2.—*Fixation of bakauan tanning extract by hide powder.*

pH of tanning solution.	Tannin fixed by 2 grams of hide powder in 24 hours.	Fixation.
	g.	*Per cent.*
0.60	0.393	22.2
0.80	0.485	27.4
1.00	0.607	34.3
1.50	0.641	36.2
1.70	0.730	41.2
2.00	0.481	27.2
2.50	0.320	18.1
3.00	0.281	15.9
3.50	0.251	14.2
4.00	0.230	13.0
4.50	0.222	12.5
5.00	0.217	12.3
5.50	0.211	11.9
5.70	0.274	15.5
6.00	0.250	14.1
6.30	0.256	14.5
6.50	0.226	12.8
6.70	0.267	15.1
7.00	0.258	14.6
7.50	0.264	14.9
8.00	0.306	17.3
8.50	0.346	19.5
9.00	0.345	19.5
9.50	0.308	17.4

NOTE.—The bakauan tanning extract contained 1.77 per cent of total solids.

TABLE 3.—*Fixation of betel-nut tanning extract by hide powder.*

pH of tanning solution.	Tannin fixed by 2 grams of hide powder in 24 hours.	Fixation.
	g.	*Per cent.*
0.75	0.473	24.5
1.00	0.834	43.2
1.50	0.898	46.5
1.75	0.834	43.2
2.00	0.985	51.0
2.50	0.961	49.8
3.00	0.559	29.0
3.40	0.422	21.9
4.00	0.636	33.0
4.50	0.370	19.2
5.00	0.327	16.9
5.50	0.254	13.2
6.15	0.557	28.9
6.85	0.731	37.9
7.00	0.694	36.0
7.50	0.528	27.4
8.00	0.514	26.6
8.50	0.500	25.9
9.30	0.411	21.3

NOTE.—The betel-nut tanning extract contained 1.93 per cent of total solids.

TABLE 4.—*Fixation of bitaog tanning extract by hide powder.*

pH of tanning solution.	Tannin fixed by 2 grams of hide powder in 24 hours.	Fixation.
	g.	*Per cent.*
0.90	0.539	28.5
1.30	0.575	30.4
1.50	0.534	28.3
1.80	0.581	30.7
2.50	0.699	37.0
3.00	0.557	29.5
3.50	0.462	24.4
4.00	0.396	21.0
4.25	0.351	18.6
4.40	0.298	15.8
4.70	0.351	18.6
5.00	0.324	17.1
5.30	0.395	20.9
5.50	0.261	13.8
6.00	0.450	23.8
6.50	0.458	24.2
7.00	0.563	29.8
7.50	0.590	31.2
8.00	0.540	28.6
8.50	0.640	33.9
8.80	0.594	31.4
9.50	0.522	27.6
10.00	0.463	24.5
10.70	0.223	11.8

NOTE.—The bitaog tanning extract contained 1.89 per cent of total solids.

TABLE 5.—*Fixation of imported black-wattle tanning extract by hide powder.*

pH of tanning solution.	Tannin fixed by 2 grams of hide powder in 24 hours.	Fixation.
	g.	*Per cent.*
0.60	0.718	48.8
1.20	0.876	59.6
1.60	0.879	59.8
2.00	0.934	63.5
2.60	0.918	62.4
3.00	0.904	61.5
3.50	0.789	53.7
4.00	0.771	52.4
4.50	0.732	49.8
5.00	0.704	50.6
5.50	0.738	50.2
6.00	0.736	50.1
6.50	0.757	51.5
7.00	0.795	54.1
7.50	0.698	47.5
8.00	0.639	43.5

NOTE.—The imported black-wattle tanning extract contained 1.47 per cent of total solids.

TABLE 6.—*Fixation of Philippine black-wattle tanning extract by hide powder.*

pH of tanning solution.	Tannin fixed by 2 grams of hide powder in 24 hours.	Fixation.
	g.	*Per cent.*
0.50	0.828	46.8
1.00	0.931	52.6
1.20	0.911	51.5
1.50	0.900	50.8
2.00	0.893	50.5
2.50	0.798	45.1
3.00	0.558	31.5
3.50	0.479	27.1
3.70	0.394	22.3
4.00	0.405	22.9
4.30	0.405	22.9
4.50	0.423	23.9
4.70	0.399	22.5
5.00	0.412	23.3
5.20	0.383	21.6
5.50	0.436	24.6
6.00	0.386	21.8
6.50	0.408	23.1
7.00	0.428	24.2
7.50	0.426	24.1
8.00	0.500	28.2
8.50	0.447	25.3
9.00	0.444	25.1

NOTE.—The Philippine black-wattle tanning extract contained 1.77 per cent of total solids.

TABLE 7.—*Fixation of kalumpit tanning extract by hide powder.*

pH of tanning solution.	Tannin fixed by 2 grams of hide powder in 24 hours.	Fixation.
	g.	*Per cent.*
0.50	0.709	34.3
1.00	0.701	33.9
1.50	0.820	39.6
1.70	0.802	38.7
2.00	0.724	35.0
2.50	0.494	23.9
3.00	0.463	22.4
3.50	0.456	22.0
4.00	0.467	22.6
4.30	0.531	25.7
4.50	0.440	21.3
5.00	0.435	21.0
5.50	0.333	16.1
5.70	0.464	22.4
6.00	0.455	22.0
6.50	0.407	19.7
6.80	0.291	14.1
7.00	0.323	15.6
7.50	0.264	12.8
7.80	1.992	96.2
8.00	1.722	83.2
8.50	1.764	85.2

NOTE.—The kalumpit tanning extract contained 2.07 per cent of total solids.

TABLE 8.—*Fixation of kamachile tanning extract by hide powder.*

pH of tanning solution.	Tannin fixed by 2 grams of hide powder in 24 hours.	Fixation.
	g.	*Per cent.*
0.80	0.477	25.1
1.20	0.593	31.2
1.50	0.761	40.0
1.60	0.671	35.3
2.00	0.630	33.2
2.40	0.604	31.8
3.00	0.531	27.9
3.60	0.477	25.1
4.10	0.465	24.5
4.40	0.475	25.0
4.50	0.524	27.6
4.80	0.492	25.9
5.00	0.458	24.1
5.50	0.531	27.9
6.00	0.455	23.9
6.50	0.462	24.3
7.00	0.441	23.2
7.50	0.402	21.2
8.00	0.281	14.8
8.50	0.334	17.6
9.00	0.314	16.5
9.50	0.272	14.3

NOTE.—The kamachile tanning extract contained 1.90 per cent of total solids.

TABLE 9.—*Fixation of myrobalan tanning extract by hide powder.*

pH of tanning solution.	Tannin fixed by 2 grams of hide powder in 24 hours.	Fixation.
	g.	*Per cent.*
1.22	0.119	6.5
1.70	0.250	13.6
2.10	0.355	19.3
2.48	0.471	25.6
3.00	0.494	26.8
3.42	0.452	24.5
4.00	0.356	19.3
4.50	0.300	16.3
5.20	0.096	5.2
5.50	0.184	10.0
6.10	0.137	7.4
6.50	0.148	8.0
7.00	0.093	5.1
7.50	0.061	3.3
8.00	0.027	1.5
8.50	0.016	0.9
9.00	0.017	0.9
10.00	0.004	0.2

NOTE.—The myrobalan tanning extract contained 1.84 per cent of total solids.

TABLE 10.—*Fixation of quebracho tanning extract by hide powder.*

pH of tanning solution.	Tannin fixed by 2 grams of hide powder in 24 hours.	Fixation.
	g.	*Per cent.*
0.65	1.008	61.1
0.80	1.033	62.6
1.00	1.003	60.8
1.30	0.993	60.2
1.55	0.980	59.4
2.00	0.982	59.5
2.30	0.930	56.4
2.70	0.630	38.2
3.25	0.613	37.2
3.60	0.504	30.5
4.10	0.492	29.8
4.50	0.497	30.1
4.75	0.542	32.8
5.00	0.469	28.4
5.30	0.465	28.2
6.00	0.671	40.7
6.50	0.541	32.8
7.00	0.674	40.8
7.40	0.689	41.8
7.75	0.696	42.2
8.00	0.735	44.5
8.50	0.618	37.5
9.20	0.312	18.9
9.50	0.159	9.6

NOTE.—The quebracho tanning extract contained 1.65 per cent of total solids.

The isoelectric point of collagen has been established to be at pH 5.0 by Thomas and Kelly,(7) using the dye fixation method, and by Porter,(3) using the degree of swelling as indicator. The latter, working with the pH range 0.3 to 11.9, found a minimum at pH 4.8, and maxima appearing at pH 2.2 and at pH 12.5. Wilson and Gallum,(12) in a study of the plumping of calfskin at 7°C., as a function of hydrogen-ion concentration, observed two minima of plumping, at pH 5.1 and at pH 7.6. They suggested that these two points represent the isoelectric points of two different forms of collagen undergoing a change in form, possibly an internal rearrangement, in passing from acid to alkaline solutions. Wilson and Kern(13) also found two minima, not far from the values obtained by Wilson and Gallum, at pH 4.7 (the generally accepted isoelectric point) and at pH 7.7. At these points they believe that gelatin exists in the gel and sol forms, respectively.

Thomas and Foster(8) have found that vegetable tannins are amphoteric in character, with the isoelectric point lying around

pH 2.0 to 2.5, being negatively charged when the hydrogen-ion concentration falls below this figure and positively charged in a more acid solution.

All these factors have bearing on the explanation of the curves obtained. Furthermore, the somewhat wavy form of the lines is characteristic of the short period of fixation as shown in a similar report of Thomas and Kelly,(6) the breaks being more or less straightened as the period of fixation is lengthened.

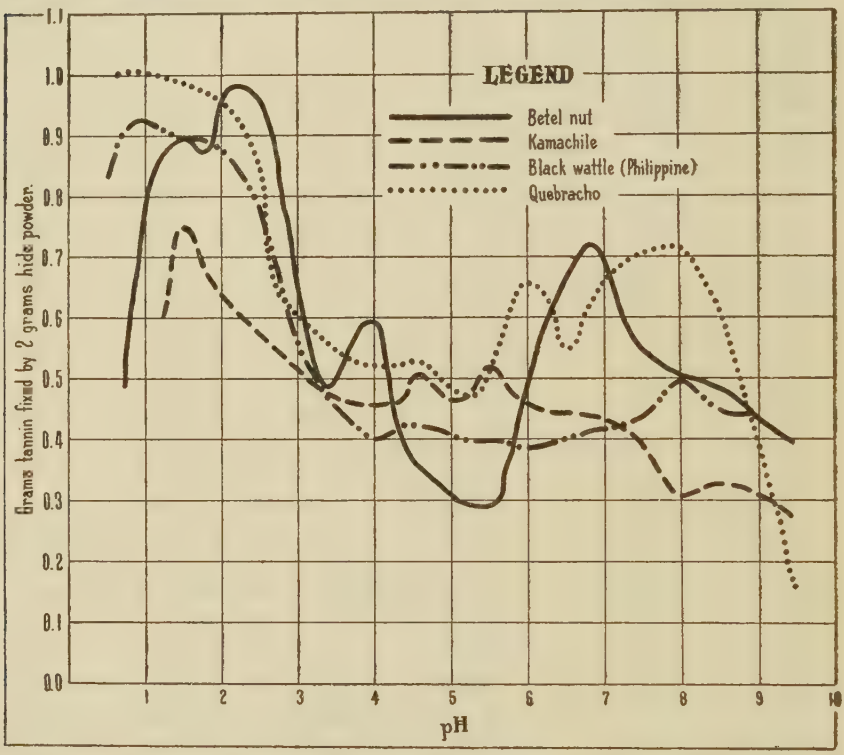

FIG. 1. Grams of betel-nut, kamachile, Philippine black-wattle, and quebracho tannins fixed by 2 grams hide powder at different pH values.

In our reported work on diffusion we found that the order of increasing rate of diffusion of the tans studied was as follows: Philippine black wattle<kamachile<bakauan<anabiong<imported black wattle<bitaog<quebracho<kalumpit<betel nut<myrobalan.

Based on their increasing nontannin : nontannin + tannin ratios, they were arranged as follows: kalumpit<quebracho<Philippine black wattle<imported black wattle< bitaog< bakauan<betel nut<myrobalan<kamachile<anabiong.

FIG. 2. Grams of anabiong, imported black-wattle, and kalumpit tannins fixed by 2 grams hide powder at different pH values.

For the purpose of comparing the fixation and diffusion characteristics of the vegetable tanning materials under investigation, we have grouped the rates of fixation under the following separate ranges: below pH 3.0, between pH values 3.0 and 5.0, and above pH 5.0 (Table 11). The degree of fixation is given in grams of tannin fixed by 2 grams of hide powder. In Table 11 the names of the tanning extracts are arranged in the order of increasing rate of diffusion as observed in the reported diffusion experiments.

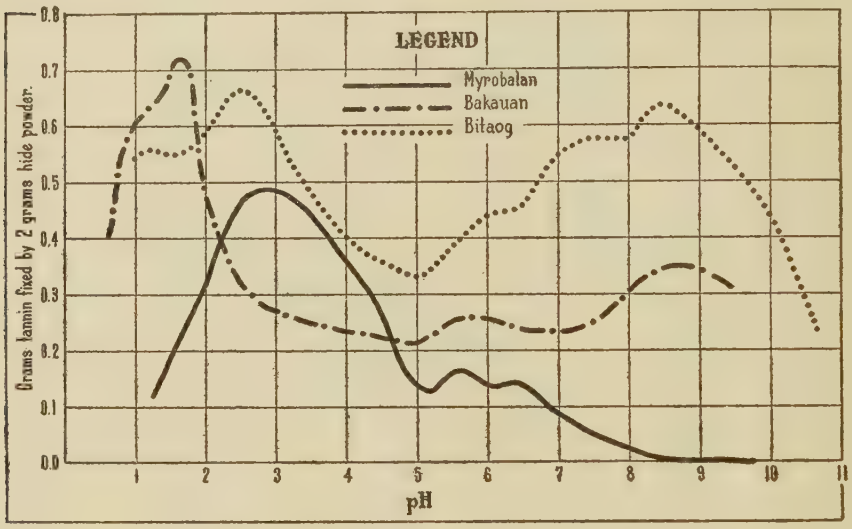

FIG. 3. Grams of myrobalan, bakauan, and bitaog tannins fixed by 2 grams hide powder at different pH values.

In Table 12 the degree of fixation of the tannin is expressed in percentage. The order of increasing rate of diffusion is determined by experiments on the diffusion, and the order of decreasing rate of fixation is based on averages of fixation values at the different ranges of pH.

Philippine black wattle, kamachile, and anabiong exhibited similar fixation characteristics, having maximum fixation below pH 3.0 and minimum above pH 5.0. Bakauan, bitaog, and betel nut may be grouped with quebracho with maximum fixation below pH 3.0 and minimum between pH 3.0 and 5.0.

Imported black wattle and myrobalan have their highest fixation between pH 3.0 and 5.0 and their lowest above pH 5.0. The reverse characteristic was exhibited by kalumpit as shown by its maximum fixation above pH 5.0 and its minimum between pH 3.0 and 5.0.

TABLE 11.—*Fixation of different tanning extracts.*

Tanning extract.	Fixation.					
	Below pH 3.0.			Between pH 3.0 and 5.0.		
	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.
	g.	*g.*	*g.*	*g.*	*g.*	*g.*
Philippine black wattle	0.798	0.931	0.877	0.394	0.558	0.434
Kamachile	0.477	0.761	0.622	0.465	0.531	0.488
Bakauan	0.393	0.730	0.522	0.217	0.281	0.240
Anabiong	0.973	1.261	1.123	0.974	1.135	1.064
Imported black wattle	0.718	0.934	0.865	0.732	0.904	0.788
Bitaog	0.534	0.699	0.586	0.298	0.462	0.392
Quebracho	0.630	1.033	0.947	0.469	0.613	0.519
Kalumpit	0.494	0.820	0.708	0.435	0.531	0.465
Betel nut	0.473	0.985	0.830	0.327	0.636	0.463
Myrobalan	0.119	0.471	0.299	0.300	0.356	0.400

Tanning extract.	Fixation.			Average fixation at different pH values.
	Above pH 5.0.			
	Minimum.	Maximum.	Average.	
	g.	*g.*	*g.*	*g.*
Philippine black wattle	0.383	0.500	0.429	0.580
Kamachile	0.272	0.531	0.385	0.498
Bakauan	0.211	0.346	0.276	0.346
Anabiong	0.792	1.443	1,034	1.073
Imported black wattle	0.639	0.744	0.727	0.793
Bitaog	0.223	0.640	0.479	0.485
Quebracho	0.159	0.735	0.556	0.674
Kalumpit	0.264	1.972	0.801	0.658
Betel nut	0.254	0.731	0.524	0.605
Myrobalan	0.004	0.184	0.078	0.259

Table 12 shows no clear-cut relation between the rates of fixation and of diffusion of the vegetable tans under study. However, the theory that the more easily diffused tan is the less astringent or less fixed, and vice versa, holds true in the case of bitaog, kalumpit, and myrobalan.

Generally tanning materials that diffuse fast and fix slowly are most suitable for initial tanning in union tannage. Materials that have fair fixation and diffusion characteristics may be used for all kinds of leather, and those that have slow or fair diffusion and fast fixation properties are most suitable for light leather tannage and also for final tanning in union tannage. Taking these points into consideration, Table 12 shows that Philippine black wattle, anabiong, and imported black wattle are most suitable for tanning light leather and for final

TABLE 12.—*Fixation of different tanning extracts.*

Tanning extract.	Fixation.					
	Below pH 3.0.			Between pH 3.0 and 5.0.		
	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Philippine black wattle	45.1	52.6	49.5	22.3	31.5	24.5
Kamachile	25.1	40.0	32.7	24.1	27.9	25.7
Bakauan	18.1	41.2	29.5	12.3	15.9	13.6
Anabiong	51.8	67.1	59.0	51.8	60.4	56.6
Imported black wattle	48.8	63.5	46.8	49.8	61.5	53.5
Bitaog	28.3	37.0	30.9	17.1	29.5	20.8
Quebracho	38.1	62.5	57.2	28.3	37.1	31.4
Kalumpit	23.8	39.6	34.2	21.0	25.7	21.8
Betel nut	24.5	51.1	43.1	16.9	33.0	24.0
Myrobalan	6.4	25.6	16.3	16.3	26.9	21.8

Tanning extract.	Fixation.			Order of—	
	Above pH 5.0.			Increasing rate of diffusion.	Decreasing rate of fixation.
	Minimum.	Maximum.	Average.		
	Per cent.	*Per cent.*	*Per cent.*		
Philippine black wattle	21.6	28.2	24.2	1	4
Kamachile	14.3	27.9	20.4	2	6
Bakauan	11.9	19.5	15.5	3	9
Anabiong	42.1	76.8	55.0	4	1
Imported black wattle	43.5	51.5	49.1	5	2
Bitaog	11.8	33.9	25.1	6	7
Quebracho	9.6	44.5	33.6	7	3
Kalumpit	14.1	96.2	34.8	8	8
Betel nut	13.1	37.9	27.1	9	5
Myrobalan	0.2	10.0	4.2	10	10

tanning in union tannage. Anabiong and imported black wattle have almost identical characteristics.

Kamachile, the tanning material most commonly used in local tanneries, is a poor diffuser and fixer. This is probably the reason why an unpleasant odor is developed, due to decomposition of the undertanned leather. Bakauan, which has fixing and diffusing characteristics similar to those of kalumpit, may be used only for union tannage.

In diffusion bitaog is similar to quebracho but it is less astringent.

Kalumpit and myrobalan, which belong to the same genus, possess similar characteristics and should be good for preliminary tanning in union tannage.

Betel nut seems to be one of the most promising local tanning materials. Being a very good diffuser and a good fixer it can be used for all kinds of leather, light and heavy. Our tests show that it has the additional advantage of producing leather of a fine natural color.(1) While there are no large plantations of betel-nut palm, this plant can easily be cultivated.

The other Philippine tanning material which has possible commercial value is anabiong. This plant is found throughout the Islands at low and medium altitudes. It grows abundantly in deserted clearings and second-growth forests. The bark comes off easily from the trunk of the tree.

SUMMARY

Fixation is the chemical or physicochemical combination of hide substance with the tannins which diffuse through its fibers.

Experiments made with Philippine and imported vegetable tanning materials to compare their rates of fixation under varying conditions of pH, show the following:

1. In general there seems to be no well-defined relationship between the rates of fixation and diffusion. However, the theory that the more easily diffused tan is the less astringent or less fixed and vice versa holds true in the case of bitaog, kalumpit, and myrobalan.

2. Philippine black wattle, anabiong, and imported black wattle, being poor diffusers and good fixers, may be used for light leather tannage and for final tanning in union tannage.

3. Kamachile and bakauan, being poor fixers and diffusers, should be suitable for union tannage.

4. In diffusion bitaog is similar to quebracho, but it is less astringent.

5. Kalumpit and myrobalan, being good diffusers and poor fixers, should be good only for preliminary tanning.

6. Of the Philippine tanning materials studied betel nut and anabiong seem to have promising commercial prospects. Betel nut is an excellent diffuser and a good fixer. Besides being suitable for all kinds of leather, it has the additional advantage of producing leather of a fine natural color. Anabiong grows abundantly in deserted clearings and second-growth forests. The bark is easily removed from the tree.

LITERATURE CITED

1. BAENS, LUZ. Tannin from the kernels of green betel nuts. Phil. Jour. Sci. 75 (1941) 363–368.
2. BAENS, LUZ, L. G. ALEJO, and V. G. LAVA. Diffusion characteristics of some Philippine vegetable tanning extracts. Phil. Jour. Sci. 72 (1940) 451.
3. PORTER, E. C. Swelling of hide powder. Jour. Soc. Leather Trades Chem. 5 (1921) 259; 6 (1922) 83.
4. STIASNY, E. The determination of dissolved hide in soak and lime liquors. Chemical Abstracts 3 (1909) 2255.
5. THOMAS, A. W., and ALEXANDER FRIEDEN. The gelatin-tannin reaction. Jour. Ind. Eng. Chem. 15 (1923) 839.
6. THOMAS, A. W., and M. W. KELLY. The influence of hydrogen-ion concentration in the fixation of vegetable tannins by hide substance. Jour. Ind. Eng. Chem. 15 (1923) 1148.
7. THOMAS, A. W., and M. W. KELLY. The iso-electric point of collagen. Jour. Am. Chem. Soc. 44 (1922) 195.
8. THOMAS, A. W., and S. B. FOSTER. The electrical charge of vegetable tanning particles. Jour. Ind. Eng. Chem. 14 (1922) 191; 15 (1923) 707.
9. THOMPSON, F. C., K. SESHACHALAM, and K. H. HASSAN. Influence of degree of acidity on the tannin content of solutions. Jour. Soc. Leather Trades Chem. 5 (1921) 389.
10. WILSON, J. A., and A. F. GALLUM JR. The points of minimum plumping of calfskin. Jour. Ind. Eng. Chem. 15 (1923) 71.
11. WILSON, J. A., and E. J. KERN. The determination of tannin. Jour. Ind. Eng. Chem. 13 (1921) 772.
12. WILSON, J. A., and E. J. KERN. Effect of hydrogen-ion concentration upon the analysis of vegetable tanning materials. Jour. Ind. Eng. Chem. 14 (1922) 1128.
13. WILSON, J. A., and E. J. KERN. Two forms of gelatin and their isoelectric points. Jour. Am. Chem. Soc. 44 (1922) 2663.

ILLUSTRATIONS

[Drawings by Francisco Rafael.]

FIG. 1. Grams of betel-nut, kamachile, Philippine black-wattle, and quebracho tannins fixed by 2 grams hide powder at different pH values.

2. Grams of anabiong, imported black-wattle, and kalumpit tannins fixed by 2 grams hide powder at different pH values.

3. Grams of myrobalan, bakauan, and bitaog tannins fixed by 2 grams hide powder at different pH values.

A SUMMARY OF KENTROCHROSIA LAUTERBACH AND SCHUMANN

By E. D. Merrill and L. M. Perry
Of the Arnold Arboretum, Harvard University, Massachusetts

In a collection of plants recently received from the Philippine National Herbarium there is a representative of the apocynaceous genus *Kentrochrosia,* hitherto unreported as such from the Philippines. *Kentrochrosia* Lauterb. and K. Schum. was established on the basis of a single species, *K. monocarpa* Lauterb. and K. Schum., from northeastern New Guinea. Its distinguishing character is the strongly compressed and laterally spurred fruit as contrasted with the terete or only slightly compressed and spurless fruit of *Kopsia* Blume. The two genera have a common floral character in the presence of two disc scales, and, except in the fruits, are very similar in habit, inflorescence, and floral characters. As a matter of fact, Markgraf,[1] in discussing the status of *Kopsia flavida* Blume, a species based on a flowering specimen collected in New Guinea by Zippelius, pointed out that these two genera differ not at all in the floral characters but only in their very different fruits. By inference he concluded that *Kopsia flavida* Blume must be the same as *Kentrochrosia* Lauterb. and K. Schum. The question of priority of specific names evidently perplexed him; for shortly after,[2] he stated the case more explicitly, noting that, since no wild *Kopsia* was known from New Guinea, *Kopsia flavida* Blume must belong to *Kentrochrosia* Lauterb. and K. Schum. However, inasmuch as the original of Blume's species is only a flowering specimen, and *Kopsia* and *Kentrochrosia* are indistinguishable by the structure of the flowers, and since claims of priority can be established only on the basis of the fruit which is lacking, it would be unsafe to take up at this time the older specific name. In both his publications Markgraf indicated that the genus was endemic in New Guinea. Since then the range of *Kentrochrosia monocarpa* Lauterb. and K. Schum. has been found to extend eastward into the Solomon Islands and the New Hebrides. Fur-

[1] Nova Guinea 14 (1925) 284. [2] Bot. Jahrb. 61 (1927) 169.

ther, two other species belonging to this genus have appeared: *Kentrochrosia carolinensis* (Kaneh.) Kaneh. and Hatus.[3] from Palau Island, Micronesia, and *K. triangularis* (Quis. & Merr.) from Surigao Province, Mindanao, both originally described as species of *Kopsia.* Hence the genus, instead of being endemic in New Guinea, is another example to be added to the lists elaborated by Merrill in the discussion of floristic relationships of the Philippine flora.[4] In this detailed consideration of alliances between the individual units and various geographic regions, *Kentrochrosia* Lauterb. and K. Schum. obviously belongs in the list of some 40 entities found in the Philippines and in one or more of the islands to the south and southeast.

The following is a summary of the material in our herbarium:

KENTROCHROSIA CAROLINENSIS (Kaneh.) Kanehira & Hatusima.

Kentrochrosia carolinensis (Kaneh.) KANEHIRA & HATUSIMA, Bot. Mag. Tokyo 53 (1939) 190, *fig. 79.*

Kopsia carolinensis KANEHIRA, Bot. Mag. Tokyo 45 (1931) 344; Enum. Micron. Pl. (1935) 395.

CAROLINE ISLANDS, Palau, Gaspan, Aimiriik, Babeldoab, *Kanehira & Hatusima 4569.*

KENTROCHROSIA MONOCARPA Lauterbach and Schumann.

Kentrochrosia monocarpa LAUTERBACH and SCHUMANN, in K. Schum. & Lauterb. Fl. Deutsch. Schutzgeb. Südsee (1900) 506, *t. 18;* MARKGRAF, Nov. Guin. 14 (1925) 283; Bot. Jahrb. 61 (1927) 195; WHITE, Jour. Arnold Arb. 10 (1929) 262.

BRITISH NEW GUINEA, Ihu, Vailala River, *Brass 939,* rain forest: Wuroi, Oriomo River, *Brass 5789,* low river bank frequently covered by tidal backwater: Sturt Island, lower Fly River, *Brass 8135,* rain forest, common on muddy river banks; Fly River, 528-mile Camp, *Brass 6853,* altitude 80 meters, in undergrowth of river floodbank forest. SOLOMON ISLANDS, San Cristobal, Star Harbor, *Brass 3110,* coastal valley: Waimasi, *Brass 3145,* coastal swamps. NEW HEBRIDES, Santa Cruz, Vanikoro, *Kajewski 581,* rain forest (white corolla with pink center).

As far as we can say from flowering specimens alone, *Kajewski 581* is a good match for the other Pauasian material here cited. The habitats are similar. In all the specimens cited above, except *Kajewski 581,* the field notes indicate a shrub or small tree up to 4 meters, having showy white flowers with

[3] Bot. Mag. Tokyo 53 (1939) 190.

[4] Enum. Phil. Fl. Pl. 4 (1926) 77–105.

a red throat. In Guillaumin, A Florula of the Island of Espiritu Santo,[5] we believe the specimen listed as *"Kopsia fruticosa* A. DC.?,-Hog Harbor, rain forest; white flower, purple center; (274) 26.i.34," ought to be compared with this genus. Our surmise is that this specimen, which we have not seen, represents the same species as *Kajewski 581* from the New Hebrides, and that the latter is *Kentrochrosia monocarpa* Lauterb. and K. Schum.

KENTROCHROSIA TRIANGULARIS (Quis. and Merr.) comb. nov.

Kopsia triangularis QUISUMBING and MERRILL, Phil. Jour. Sci. 37 (1928) 191.

PHILIPPINE ISLANDS, MINDANAO, Surigao Province, *Wenzel 2648, 2706,* June and July, 1927; *Bur. Sci. 83386 Ramos and Convocar* from Lake Mainit, March–April, 1931.

The known generic range of the group is now Mindanao in the southern Philippines, New Guinea, Solomon Islands, the New Hebrides Islands, and the Caroline Islands (Palau). It is not unreasonable to expect its occurrence in such islands as Celebes, Gilolo, and perhaps in some islands of the Molucca group.

[5] Jour. Linn. Soc. Bot. 51 (1938) 556.

MISCELLANEOUS FERNS OF NEW GUINEA [1]

By Edwin B. Copeland
Of the University of California, Berkeley

MARATTIA BRASSII Copeland sp. nov.

Rhachibus paleis deciduis ferrugineis et amorphis fibrillosis et rarioribus lanceolatis integris 2 mm longis sparsis, denique nudis, mollibus, superne in linea mediale nigris alibi brunneis, secundariis anguste brunneo-alatis; pinnulis sessilibus, maximis (in parte inferiore frondis) 15 cm longis, 16 mm latis, basi latere basiscopico rotundatis acroscopico late cuneatis, ubique argute serrulatis, supra mediam longitudinem contractis et deinde sensim longe attenuatis, subcoriaceis, ad costam inferne decidue pallide paleatis, alibi glabris; venis late patentibus, in pinnis maximis fere 2 mm inter se remotis, opacis; synangiis 1.5 ad 2 mm a margine remotis, 3 mm longis, circa 12-locularibus, indusio conspicuo lacerato; pinnulis parte superiore frondis circa 7.5 cm longis, partibus omnibus proportionalibus.

Dutch New Guinea, *Brass No. 12117*, 15 kilometers southwest of Bernhard Camp, Idenburg river, altitude 1,800 meters, "fronds usually 3.2 long."

This is a member of the large central group of the genus often confused with *M. fraxinea*, and is distinguished by the peculiar shape of the pinnules.

MARATTIA CORONATA Copeland sp. nov.

M. tafaensi affinis fronde tripinnata pinnulis secundariis distalibus maximis; rhachi primaria deorsum 15 mm crasso, fusco, postquam dejectis paleis tuberculis munita; pinnis 60 cm longis, infimis stipitulis 4 cm longis donatis, rhachibus purpurascentifuscis, paleis ferrugineis 1 ad 2 mm longis integris vel plerisque laceris sparsis sat persistentibus vestitis, linea mediana superne atropurpurascente; pinnulis[i] patentibus fere sessilibus, circa 15 cm longis, linearibus, apices versus dilatatis, rhachibus sparse paleaceis, inter pinnulas[ii] anguste alatis; pinnutis[ii] numeros-

[1] This paper includes the fourth report on the ferns collected by the Third Archbold Expedition to New Guinea. Previous reports were published in Phil. Jour. Sci. 73 (1940) 345–357; 457–469; 75 (1941) 347–361.

issimis, typice ovatis, hic uniforme 6 mm longis 5 mm latis, acutis, basi cuneatis, serratis dentibus 1 ad 3, obscure viridibus, subcoriaceis, glabris, terminalibus circa 3 cm longis lanceolatis acuminatis, subterminalibus etiam lanceolatis minus elongatis sterilibus; synangiis ad pinnulam quamque circa 3, magnis, loculis 8- ad 10-paribus, indusio primo conspicuo, lacero, ferrugineo, denique evanido. Plantarum aliarum pinnulis[ii] majoribus, ordinatim 10 mm vel 13 mm longis, ad vix iis typi latioribus, synangiis superficiem fere complentibus 3- ad 5-paribus.

DUTCH NEW GUINEA, *Brass No. 12116,* type, 15 kilometers southwest of Bernhard Camp, Idenburg river, altitude 1,800 meters, "Common in undergrowth in gullies. Leaves usually 3, about 2.5 m long, arched and spreading, from a fleshy subglobose stock about 20 cm in diam." *No. 12116A,* with the type, secondary pinnules a little larger, the primary pinnules near the tip of the pinna undivided, 7 cm long, caudate. *No. 11484,* Bele river, altitude 2,300 meters, secondary pinnules 10 to 12 mm long. *No. 10765,* near Lake Habbema, altitude 2,750 meters, secondary pinnules about 15 mm long, lanceolate; possibly distinct but not to be so judged by a single collection.

No. 12902, altitude 1,200 meters, may be *M. tafaensis* or may be a distinct species. Neither the specimen nor the notes shows whether it is bipinnate or tripinnate. The leaflets are about 15 mm long, broadly lanceolate acute, falcate, almost entire. The rachises are glabrescent. The terminal leaflets are enlarged; whether or not this is so of *M. tafaensis* is not known.

M. coronata is one of a group that may be typified by its first described species, *M. melanesica* Kuhn, from which it differs, *inter alia,* by persistent scaliness. *M. Werneri* is apparently distinguished by the presence of a single synangium borne on the costa of each fertile pinnule; the single known specimen is immature, the synangia still almost concealed by the dissected indusia. *M. coronata* differs from *M. tafaensis* by its persistent scaliness, and in that the latter, so far as known, is only bipinnate. We need information as to the variability of *Marattia,* and as to correlation among the supposed specific criteria.

MARATTIA MEGAPTERA Copeland sp. nov.

Stipite sicco collapso 1 cm crasso, castaneo, spinis 1 ad 1.5 mm altis validis sparsis armato, paleis 1 ad 6 mm longis obscuris vivo scilicet carnosis sparso; pinna 50 cm longa, stipitulo ejus 10 cm longo incluso, rhachi sicca rugosa haud alata, fusca,

minute nigro-verruculosa; pinnulis 4-paribus impari carente, breviter (4 mm) pedicellatis, 20 ad 25 cm longis, 5 ad 6 cm latis, basi subaequali-cuneatis, apice acutis et deinde (apicem extendiente) caudatis cauda 15 mm longa 1 ad 2 mm lata, margine infra caudam minute serrulato alibi integro, subcoriaceis, glabris sed costa squamulis minutis ferrugineis sparsa; venis haud densis, tenuissimis, opacis; soris permultis, 0.5 ad 2.5 mm a margine remotis, 2 ad 3 mm longis, usque ad 20 locularibus, indusiis brevibus (vetustate) integris inconspicuis.

DUTCH NEW GUINEA; *Brass No. 13668,* 2 kilometers southwest of Bernhard Camp, Idenburg river, altitude 750 meters. "One plant on slope in rain forest, leaves 2; stipe of larger leaf 1.43 m, lamina 0.65 m."

Evidently near *M. obesa* Christ, but apparently different in its caudate tips, entire margin, large synangia, and in other respects. The spinose stipe may seem very novel, but the stipes of many species are undescribed, and minor tubercles occur on the stipes of several.

SCHIZAEA PAPUANA Brause.

Brass 9089, altitude 3,225 meters; *Brass & Myer-Drees 10018, 10385,* altitude 3,560 and 3,700 meters, all in boggy grass. All are one species, though *No. 9089* has darker bristles on the rhizome and more numerous fertile pinnæ, the other two collections being dwarfed; the tallest frond of *No. 10018* does not reach 8 cm. All examples have exceedingly slender "fronds." I have not seen authentic *S. papuana,* described as an epiphyte in moss cushions in the crown of a tree,—not a typical place for any *Schizaea,*—and may err in the identification. *S. papuana* is reduced to *S. malaccana* in Index Suppl. III, 170, but the collections in hand are not that species. They might be regarded as dwarfed *S. fistulosa,* but seem distinct to me.

NEW OR LITTLE-KNOWN TIPULIDÆ FROM EASTERN ASIA (DIPTERA), XLIV

By Charles P. Alexander
Of Amherst, Massachusetts

FOUR PLATES

In the present article I am discussing crane flies from several localities in Asia, including the following countries and collectors: Manchukuo: Weymarn; Japan: Esaki, Issiki, Machida, and Suenson; China and Indo-China: Brownell, Cooman, Franck, Graham, Kellogg, Klapperich, Piel, Suenson, and Tsen; the Philippines: Rivera; and British India: Nathan and Sircar. I am greatly indebted to all of the above scientists and collectors for their interest in saving specimens of these flies. Except where indicated to the contrary in the text, the types of the novelties are preserved in my collection of these flies.

TIPULINÆ

TANYPTERA CHRYSOPHÆA sp. nov. Plate 1, fig. 1; Plate 2, fig. 25.

General coloration brownish yellow to reddish yellow; antennæ and halteres yellow throughout; basal three flagellar segments elongate-cylindrical, outer segments short-oval; legs yellow, outer tarsal segments black; wings with basal two-thirds intense yellow, especially the costal portion, apex broadly brown; Rs exceeding twice length of m-cu; abdomen with cerci long and relatively narrow.

Female.—Length, about 24 millimeters; wing, 18; antenna, about 5.5.

Frontal prolongation of head brownish yellow, without nasus, setæ yellow; palpi with basal three segments brownish yellow, terminal segment black. Antennæ (Plate 2, fig. 25) yellow throughout; first flagellar segment elongate, subequal in length to scape; second segment about two-thirds as long as first; third segment about three-fourths as long as second; remaining segments conspicuously smaller, especially seventh to twelfth, inclusive, which are irregularly short-oval; terminal segment abruptly smaller. Head dull black; anterior vertex wide.

Pronotum obscure yellow. Mesonotal præscutum shiny obscure yellow or brownish yellow, with three more reddish stripes, median stripe with a capillary black median vitta on cephalic third of sclerite; a lateral brown spot on margin behind humeri; setæ or præscutal interspaces golden yellow; posterior sclerites of notum reddish yellow, parascutella darker. Pleura yellow, variegated with black on ventral anepisternum, ventral sternopleurite, pteropleurite, meron, and ventral pleurotergite. Halteres yellow throughout. Legs with coxæ and trochanters yellow; femora and tibiæ yellow, unmarked; tarsi passing through brownish yellow to black. Wings (Plate 1, fig. 1) with basal two-thirds intense yellow, distal third beyond cord medium brown; prearcular field, costal border, and a seam along vein Cu more saturated yellow; stigma yellow; basal third of cell 1st M_2 and adjoining part of cell M_3 of yellow ground color; outer ends of cells Cu and 1st A brown; veins yellow in saturated portions, remainder, including Rs, M, and anal veins brown. Venation: Rs relatively long, exceeding twice length of m-cu; R_2 relatively long and conspicuous, so R_1 and R_{1+2} are in virtual longitudinal alignment; petiole of cell M_1 about one-half m; m-cu just before fork of M_{3+4}.

Abdomen uniformly reddish yellow; ovipositor with cerci long and relatively narrow, much narrower than in *antica* but wider than in typical members of the genus. Similarly, the preceding genital segments are shorter and less attenuated than in typical forms, as *atrata*.

Habitat.—China, Fukien.

Holotype, female, Kuatun, altitude 2,500 to 3,000 meters, April 15, 1936 (*Klapperich*); type returned to the Zoologisches Forschungsinstitut, Bonn, Germany.

Tanyptera chrysophæa is readily told from other regional species by the coloration, especially the pattern of the wings, and by the structure of the ovipositor.

CTENACROSCELIS PERSESSILIS sp. nov. Plate 1, fig. 2.

General coloration of mesonotum dark brown, præscutum with four slate-gray stripes; antennæ black, intermediate flagellar segments strongly produced on ventral face; posterior sclerites of mesonotum yellow; pleura pale brown with a golden-yellow longitudinal stripe; halteres and legs brownish black; wings with a strong brownish tinge; a strong element R_{1+2+3} before fork of R_{1+2} and R_3; cell M_1 broadly sessile; abdominal tergites

dark brownish gray, lateral borders of segments paling to buffy; genital shield of ovipositor chestnut-brown.

Female.—Length, about 30 millimeters; wing, 27.

Frontal prolongation of head elongate, subequal to or a little longer than remainder of head, dark brown, narrowly light gray-pruinose along dorsal surface; nasus conspicuous; palpi black. Antennæ black, scape pruinose; first flagellar segment long-cylindrical, exceeding scape in length; fifth to eighth flagellar segments, inclusive, with ventral face strongly produced; terminal three segments nearly cylindrical, last shortest, about one-half penultimate. Head gray-pruinose, with a brownish median vitta; vertical tubercle low.

Pronotum dark brown medially, paling to buffy yellow on sides. Mesonotal præscutum with ground color dark brown, virtually restricted to humeral portions of sclerite, remainder of disc with four slate-gray stripes, intermediate pair of stripes separated by a ground vitta except at suture where all four stripes become confluent; lateral portions of præscutum dark brown, extreme cephalic margins of anterior portion of sclerite buffy; scutal lobes slate-gray, median area behind suture with a very conspicuous dark-brown triangular area, remainder of scutum obscure yellow; scutellum obscure yellow, restrictedly darkened medially in front, parascutella dark; mediotergite yellow. Pleura pale brown, with a more golden-yellow longitudinal stripe from behind fore coxæ to base of abdomen, this stripe covered with delicate silken setulæ; ventral sternopleurite darker brown; dorsopleural membrane buffy. Halteres brownish black, base of stem restrictedly pale. Legs with coxæ dark brown, pruinose; trochanters black, sparsely pruinose; remainder of legs brownish black. Wings (Plate 1, fig. 2) with a strong brownish tinge, centers of cells M, 2d A, and outer medial cells more brownish yellow; veins brown. Venation: Sc_1 preserved as a strong spur; R_1 beyond free tip of Sc_2 strongly longitudinal in position, forming a relatively long fusion of R_{1+2+3}; R_3 only moderately sinuous, cell but little constricted at midlength, wide at margin; cell M_1 broadly sessile; cell 1st M_2 elongate, outer end narrowed; m-cu at fork of M_{3+4}.

Abdominal tergites dark brownish gray, lateral borders of segments paling to buffy; basal sternites dark gray, outer segments paling to reddish brown. Ovipositor with genital shield chestnut-brown, valves dark chestnut-brown.

Habitat.—China, Szechwan.

Holotype, female, Hai-tsi-pin, altitude 13,000 feet, July and August 1937 (*Graham*) ; United States National Museum.

Ctenacroscelis persessilis is quite distinct from all other species of the genus so far made known, differing conspicuously in the coloration and in the venation, as the broadly sessile cell M_1.

TIPULA (YAMATOTIPULA) KAMIKOCHIENSIS sp. nov. Plate 1, fig. 3; Plate 2, fig. 26.

Belongs to the *iroquois* group, allied to *machidai;* large (wing, male, 20 millimeters) ; antennæ relatively short, flagellum black; basal enlargements of segments only poorly developed; general coloration of notum gray, pronotum, scutum, and scutellum with a median brown vitta; femoral tips broadly blackened; tibiæ black, extreme bases pale; wings brownish yellow, restrictedly patterned with darker, including outer radial field; wing petiole long; abdominal tergites yellow, lateral borders gray, median area with a nearly continuous black stripe; hypopygium black; male hypopygium with apical portion of tergite flattened, yellow, caudal margin with a V-shaped notch; outer dististyle pale, truncated at apex; inner dististyle with apex of rostral prolongation broadly obtuse, outer margin of style with two blackened points, longest point an acute spine that is directed outward.

Male.—Length, about 16 millimeters; wing, 20; antenna, about 3.

Frontal prolongation of head dark brown, grayish pruinose, relatively short, about one-half remainder of head; nasus long and slender; palpi brownish black, moderately long terminal segment pale on basal half, infuscated on distal portion. Antennæ relatively short; scape brownish yellow, more darkened outwardly; pedicel brown; flagellum black; flagellar segments with basal enlargements only poorly developed, verticils longer than segments; terminal segment reduced, pointed at apex. Head gray, with a narrow, dark-brown, median vitta; vertical tubercle small.

Pronotal scutum gray, with a narrow, median, dark-brown vitta, scutellum pale yellow. Mesonotal præscutum light gray, with four conspicuous brown stripes, intermediate pair of stripes separated by a dark-gray central area, mesal edges of stripes vaguely indicated by capillary dusky lines; lateral stripes entire, without differentiated margins; humeral region restrictedly buffy, lateral præscutal border behind humeri dark; posterior sclerites of notum dark gray with a slightly darker median vitta extending from suture to about midlength of scutellum; post-

notum clearer gray. Pleura light gray on mesepisternum, anepisternum and ventral sternopleurite darker gray; meron gray, darker ventrally; pteropleurite and pleurotergite, with the dorsopleural membrane, more buffy yellow, pleurotergite more darkened immediately above the halteres. Halteres with stem brownish yellow, knob dark brown. Legs with coxæ light gray; trochanters obscure yellow; femora yellow, tips broadly blackened, on fore pair occupying nearly distal fourth, narrower on posterior femora where only about outer sixth is included; tibiæ black, bases narrowly obscure yellow; tarsi black; claws with strong lateral spine. Wings (Plate 1, fig. 3) brownish yellow, prearcular and costal fields somewhat clearer yellow; stigma oval, dark brown; wing tip, especially in outer radial field, weakly infuscated; Cu narrowly seamed with brown, much more conspicuous on the distal section and along m-cu; vein 2d A restrictedly seamed with darker; veins brownish black, paler in brightened portions. Wing base long and petiolate; squama naked. Venation: M_{3+4} shorter than basal section of M_{1+2}; cell 2d A relatively wide.

Abdomen with basal tergite yellow basally and on sides, brownish pruinose behind; succeeding tergites yellow, lateral borders broadly gray, median portion with a conspicuous brownish-black stripe that is narrowly interrupted at caudal border of segment; sternites light yellow; outer segments and hypopygium uniformly blackened. Male hypopygium (Plate 2, fig. 26) with tergite, 9*t*, produced caudad into a very flattened, depressed, yellow blade, the caudal margin of which bears a V-shaped notch, median area beneath more or less carinate; ventral surface of pale apical portion on either side with a yellow flattened lobe; cephalic portion of tergite blackened and with abundant black setæ, forming a densely setiferous triangular block in the central portion, point of triangle directed caudad. Basistyle not or only weakly produced at apex, its outer surface with several long, yellow setæ. Outer dististyle, *od*, a pale flattened blade, apex truncated, outer margin strongly dilated or bellied outwardly. Inner dististyle, *id*, as shown, bearing a short, obtuse, blackened point that is directed backward, and a longer, black, acute spine directed outwardly; rostrum broadly obtuse, blackened. Gonapophyses only weakly obtuse at tips.

Habitat.—Japan, Honshiu.

Holotype, male, Kamikochi, altitude 5,000 feet, July 26, 1939 (*Suenson*).

This interesting fly is most nearly related to *Tipula* (*Yamatotipula*) *machidai* Alexander and *T.* (*Y.*) *sempiterna* Alexander among the described regional species, differing from both especially in the distinct structure of the male hypopygium. The antennæ are much shorter than in *machidai,* while body size and general coloration differ in all three species. I had earlier [1] referred the species of this group to the subgenus *Oreomyza* Pokorny. The recent discovery of several new species in the southern Appalachian Mountains of eastern North America now seems to indicate that the three Japanese species, as well as the five eastern Nearctic members of the *iroquois* group, are better referred to the subgenus *Yamatotipula* Matsumura.

TIPULA (YAMATOTIPULA) SUENSONI Alexander.

Tipula suensoni ALEXANDER, Encycl. Ent. Diptera 2 (1925) 89–91, figs. 4, 5.

Kuliang, Fukien Province, eastern China, 1,500 to 2,500 feet, April 6 to 13, 1938; 1,800 to 2,000 feet, July 1 to 7, 1938 (*Kellogg*).

TIPULA (ACUTIPULA) RECEPTOR sp. nov. Plate 1, fig. 4; Plate 2, figs. 27 and 28.

Allied to *quadrinotata;* general coloration of notum brownish gray, præscutum with four narrow, darker brownish-gray stripes; scutellum and postnotum clearer gray, pleura yellow; femora yellow, tips narrowly but conspicuously infuscated; wings with a weak brown pattern, sparsely variegated with cream-colored areas; a small brown cloud before midlength of cell Cu; Rs subequal in length to m-cu; male hypopygium with median lobe of tergite large, divided into two flaplike blades set with numerous black spinules; eighth sternite unprovided with brushes of setæ.

Male.—Length, about 15 to 16 millimeters; wing, 16 to 17; antenna, about 3 to 3.1.

Frontal prolongation of head brown; nasus elongate; palpi brown. Antennæ of moderate length; basal three or four segments obscure yellow, succeeding segments weakly bicolored, darker basally than at tips, outer segments more uniformly infuscated; basal swellings of segments only poorly indicated; verticils relatively short. Head brownish gray with a narrow, dark-brown, median line; anterior vertex about two and one-half times diameter of scape.

[1] Phil. Jour. Sci. 57 (1935) 122.

Pronotum obscure brownish yellow, with a distinct median impression. Mesonotal præscutum brownish gray with four narrow, darker brownish-gray stripes that are vaguely bordered by darker; scutum brownish gray; scutellum and postnotum clearer gray, the former not darker behind but with vague indications of a darker median vitta. Pleura yellow, dorsal pleurotergite dark. Halteres elongate, dark brown. Legs with coxæ and trochanters yellow; femora yellow, tips narrowly but conspicuously infuscated, the amount subequal on all legs; tibiæ brownish yellow, tips weakly darkened; tarsi elongate, light brown, terminal segments passing into black. Wings (Plate 1, fig. 4) with a weak brown pattern, variegated with cream-colored areas, the latter most evident as a broad obliterative streak at cord and across bases of cells M_1 to M_4, inclusive; cell Cu whitened basad of the darkened area before midlength, the latter relatively small; cells C and Sc, with stigma, slightly darker than ground; a slight darkened wash near outer end of cell M; veins brown, pale in obliterative streak. Wing of paratype slightly wider than that of type. Venation: Rs subequal to or a trifle longer than m-cu, the latter a short distance before fork of M_{3+4}.

Abdominal tergites obscure yellow, with indications of a slightly darker median stripe, more distinct on outer segments; lateral tergal borders continuously darkened; sternites obscure yellow, outer three segments uniformly dark brown. Male hypopygium with median lobe of tergite (Plate 2, fig. 27, 9*t*) conspicuous, appearing as two flattened blades separated by a conspicuous U-shaped notch, lobes set with abundant, very short, blackened pegs. Apex of basistyle (Plate 2, fig. 28, *b*) produced into a short lobe bearing a brush of long yellow setæ that much exceed the lobe in length. Outer dististyle, *od*, pale, narrowly obtuse at apex, widely dilated across basal third, width at this point about two-thirds length. Inner dististyle (Plate 2, fig. 28, *id*) complex, as illustrated, consisting of a long outer spine, acute apical point distinctly darkened and set off by a weak constriction; between this spine and beak a smaller, straight spine; beak relatively small, flattened; setæ on face of style very long but slender. Ninth sternite with the usual dense brushes of setæ on either side of midline. Eighth sternite almost glabrous, posterior margin with only scattered setæ, quite without hair brushes or pencils as found in related Oriental species.

58000——3

Habitat.—Assam, Khasi Hills.

Holotype, male, Cherrapunji, altitude 4,000 feet, 1935 (*Sircar*).

Paratopotype, male.

The closest regional ally of the present fly is evidently *Tipula* (*Acutipula*) *quadrinotata* Brunetti, which differs in details of coloration of body, legs, and wings, but especially in the structure of the male hypopygium, notably the tergite, outer dististyle, inner dististyle, and the eighth sternite, the last structure having conspicuous hair brushes that are lacking in the present fly.

TIPULA (SCHUMMELIA) CRASTINA sp. nov. Plate 1, fig. 5; Plate 2, fig. 29.

Belongs to the *variicornis* group; general coloration brown, præscutum brownish yellow with three darker-brown stripes, central stripe much paler in front and divided by a capillary dark-brown vitta; posterior sclerites of notum brown; antennæ bicolored, segments yellow with dark-brown bases; legs black, femoral bases obscure yellow, narrowest on fore pair; wings with a brownish tinge, sparsely patterned with darker brown; large cream-colored areas before and beyond large dark-brown stigma; cell 1st M_2 small, its proximal end lying far basad of other elements of anterior cord; male hypopygium with tergite produced medially into a broad, more or less depressed lobe; eighth sternite moderately sheathing, without lobes.

Male.—Length, about 9 to 9.5 millimeters; wing, 10 to 10.5; antenna, about 3.5 to 3.6.

Frontal prolongation of head brown; nasus stout; palpi dark brown. Antennæ (male) of moderate length; basal three segments yellow, all remaining segments bicolored, basal enlargement dark brown, the more extensive apical portions yellow; basal enlargements only feebly developed; longest verticils a trifle shorter than segments. Head grayish brown to dark brown, anterior vertex a little brightened; a more or less evident capillary, median, dark vitta.

Pronotum brown. Mesonotal præscutum with ground color brownish yellow, with three darker-brown stripes, central stripe divided by a capillary, darker brown, median vitta; cephalic two-thirds of median stripe much paler, not or scarcely differentiated from the ground; lateral stripes entire; lateral and humeral portions of præscutum slightly darkened; scutum with median area obscure yellow, lobes chiefly darkened; scutellum

and mediotergite brown, sparsely pruinose. Pleura almost uniformly dark brown; dorsopleural region dusky. Halteres with stem and apex of knob obscure yellow, base of knob dark brown. Legs with coxæ brownish testaceous; trochanters yellow; remainder of legs black, femoral bases yellow, narrowest on forelegs, more extensive on posterior pair, involving basal third to half; claws small, simple. Wings (Plate 1, fig. 5) with a brownish tinge, prearcular and costal regions more brownish yellow; stigma large, oval, dark brown; narrow but conspicuous brown seams along cord and vein Cu; much narrower seams on outer radial veins, Rs and 2d A; wing apex and posterior border narrowly seamed with darker; conspicuous cream-colored areas before and beyond stigma; obliterative areas crossing cell 1st M_2; veins brown, paler in costal and prearcular fields. Venation: Rs relatively long, arcuated, exceeding m-cu; R_2 oblique, in approximate longitudinal alignment with R_{1+2}; cell 1st M_2 small, its inner end lying far proximad of other elements of anterior cord; m-cu before midlength of M_{3+4}, in the type specimen only a short distance beyond fork of M.

Abdominal tergites obscure yellow, posterior and lateral borders darkened; a more or less distinct brown, median vitta; outer segments, including the small hypopygium, brownish black; sternites obscure yellow. Male hypopygium (Plate 2, fig. 29) with ninth tergite, 9*t*, produced medially into a broad, more or less depressed lobe, the sides of which are densely hairy; lateral tergal lobes broad, truncated and feebly emarginate at apices. Outer dististyle, *od*, relatively broad and flattened, pale throughout. Inner dististyle, *id*, simple, oval in outline, with abundant black retrorse setæ over the surface; beak slender, blackened. Eighth sternite, 8*s*, moderately large and sheathing, margin unarmed with lobes or modified groups of setæ.

Habitat.—China, Fukien.

Holotype, male, Kuliang, altitude 1,800 to 2,000 feet, June 1 to 3, 1937 (*Kellogg*). Paratopotype, male, altitude 2,000 feet, May 22 to 27, 1937.

Tipula (*Schummelia*) *crastina* is entirely distinct from other small regional species of the subgenus. It is most similar to species such as *T.* (*S.*) *insulicola* Alexander, yet entirely distinct.

TIPULA (OREOMYZA) LACUNOSA sp. nov. Plate 1, fig. 6; Plate 3, fig. 30.

Allied to *quadrifasciata;* general coloration gray, præscutum with four darker brownish-gray to brown stripes; præscutal

interspaces with conspicuous setigerous punctures; antennæ with basal three segments yellow, remainder of flagellum almost uniformly black; halteres obscure yellow, base of knob weakly darkened; legs black, femoral bases yellow, narrowest on forelegs; wings whitish subhyaline, with four more or less complete dark crossbands; R_{1+2} chiefly atrophied; male hypopygium with outer dististyle very expanded; inner dististyle with a long glabrous rod on outer margin at base; outer margin of beak without conspicuous modified setæ; gonapophyses consisting of strong blackened spines.

Male.—Length, about 10 millimeters; wing, 11.5; antenna, about 3.5.

Female.—Length, about 12 to 13 millimeters; wing, 11.5 to 12.

Frontal prolongation of head gray-pruinose above, darker laterally; nasus distinct; palpi black. Antennæ relatively short; basal three segments light yellow, succeeding two segments black with extreme tips paling to reddish, outer segments uniform black; basal swellings of segments not or scarcely differentiated; verticils a little shorter than segments; terminal segment reduced. Head brownish gray, front and orbits clearer gray; a scarcely evident darker median vitta.

Pronotum brownish gray. Mesonotal præscutum light gray with four darker brownish-gray to brown stripes; punctures of interspaces brown, large, conspicuous; scutum gray, each lobe with disconnected brown areas, space between latter with several setigerous punctures; scutellum gray, narrowly darkened medially; postnotum light gray, mediotergite with indications of a capillary dark vitta. Pleura gray, dorsopleural membrane pale yellow. Halteres obscure yellow, base of knob weakly darkened. Legs with coxæ gray; trochanters brownish yellow; femora obscure yellow basally, tips broadly black, most extensive on fore pair where distal three-fourths or more is blackened, on posterior legs including about outer half or less; tibiæ and tarsi black; claws (male) with basal tooth. Wings (Plate 1, fig. 6) whitish subhyaline, with four more or less complete dark crossbands, first crossband postarcular, second at level of origin of Rs, much widened but paler in posterior portion; third band at cord, fourth band apical, darker in radial field; cell C dark brown, Sc more brownish yellow; stigma dark brown; broad, entire white band beyond cord narrowest at cephalic border in basal portion of cell Sc_2 and at posterior end in cell M_3, very wide in radial field; outer medial veins very narrowly seamed

with brown though scarcely interrupting white band; anterior prearcular field dark, posterior portion whitish, including veins; veins dark brown, pale yellow in ground areas. Venation: Rs very long, approximately three times m-cu or nearly so; tip of R_{1+2} atrophied.

Abdominal tergites reddish brown, sparsely pruinose, with a darker-brown median stripe that becomes widened behind, posterior borders of segments pale, sparsely pruinose; no distinct darkened lateral stripes; sternites reddish brown, outer segments more pruinose. Male hypopygium (Plate 3, fig. 30) with ninth tergite, 9*t*, broadly emarginate, with a tiny median notch from which a dorsal furrow extends cephalad the length of the sclerite; lateral lobes yellow, short, obtuse. Outer dististyle, *od*, a very broadly expanded pale blade. Inner dististyle, *id*, with a long glabrous rod on outer face at base, with a setiferous flange just distad of it; beak of style blackened, relatively narrow; no series of strong marginal setæ as in *quadrifasciata*. Gonapophyses conspicuously spinous, as shown. Eighth sternite with numerous long, pale setæ on median portion of caudal margin, with an additional brush in membrane between eighth and ninth sternites.

Habitat.—China, Fukien.

Holotype, male, Kuliang, altitude 1,500 to 2,500 feet, April 6 to 13, 1938 (*Kellogg*). Allotopotype, female, April 10, 1938. Paratopotype, 1 female, altitude 2,000 feet, April 20, 1938.

Most closely related to the Japanese *Tipula* (*Oreomyza*) *quadrifasciata* Matsumura, differing especially in the structure of the male hypopygium, especially the dististyles and gonapophyses.

TIPULA (OREOMYZA) SUBDEPRESSA sp. nov. Plate 1, fig. 7; Plate 3, figs. 31 to 33.

Allied to *depressa;* mesonotal præscutum gray with four narrow but conspicuous dark-brown stripes; fore femora black with only the bases narrowly brightened, remaining femora obscure yellow, tips rather narrowly blackened; wings brown, variegated by more cream-colored areas before cord and beyond stigma; male hypopygium with lateral tergal arms acute, with a narrow blackened inner lobe; inner dististyle with basal outer lobe separated from main body of style by a circular notch; eighth sternite with median pale lobe about two and one-half times as long as wide.

Male.—Length, about 14 millimeters; wing, 16; antenna, about 4.1.

Frontal prolongation of head black, heavily pruinose; nasus distinct; palpi black. Antennæ of moderate length; scape reddish brown, darker above and at base; pedicel yellow; flagellum uniformly black; flagellar segments moderately incised, the longest verticils a trifle shorter than segments. Head brownish gray, lighter in front, more suffused with darker behind; a capillary, dark-brown, median vitta extending from low vertical tubercle backward, becoming obsolete at near midlength of posterior vertex.

Pronotum brownish gray. Mesonotal præscutum gray, with four narrow but conspicuous dark-brown stripes, intermediate pair of stripes forming the broad borders of a darker-gray, median area, narrowed behind; the gray central portion nearly twice as wide as the dark stripes at cephalic portion of sclerite; lateral stripes narrow; posterior sclerites of mesonotum gray, each scutal lobe with two dark-brown areas; central portion of scutellum more darkened; mediotergite with a capillary dusky line. Pleura dark gray, with a more or less distinct lighter-gray area across ventral anepisternum, pteropleurite, and pleurotergite; dorsopleural membrane buffy. Halteres with stem yellow, knob dark brown. Legs with forecoxæ gray, remaining coxæ gray basally, paling to buffy at tips, buffy color unusually broad on posterior pair; trochanters yellow; fore femora black, only basal fifth or sixth brightened; middle and hind femora obscure yellow, brighter at base, tips (distal sixth or seventh) blackened; tibiæ dark brown, tips very narrowly black, fore tibiæ more uniformly brownish black; tarsi black; claws simple, hairy. Wings (Plate 1, fig. 7) with a strong brown tinge, prearcular field and cell Sc yellowish; cell C more brownish yellow; stigma brown; a conspicuous cream-colored poststigmal area in subbasal portions of outer radial field, with similar areas before cord in cells R_1, R, and M; a restricted obliterative streak crossing cell 1st M_2 into base of cell M_3; a pale marginal streak in cell 1st A near tip of vein 2d A; brown ground color deepening to a conspicuous seam along veins Cu and Cu_1; veins brown, yellow or brownish yellow in brightened costal portions. Squama naked. Venation: R_{1+2} entire; Rs about twice m-cu; basal section of M_{1+2} shorter than M_{3+4}.

Abdominal tergites yellow, conspicuously trivittate with brownish black, lateral stripes paler on extreme margins of sclerite; sternites yellow; terminal segments more uniformly blackened, central portion of tergite and distal portions of ninth

sternite obscure yellow. Male hypopygium with caudal margin of tergite (Plate 3, fig. 31, 9*t*) conspicuously toothed and blackened, including a strong, acute, median tooth that is flattened and has a carinate dorsal ridge; lateral angles of caudal border produced into acute points, with a longer, entirely blackened inner lobe that is irregularly lobed at apex. Outer dististyle (Plate 3, fig. 32, *od*) strongly flattened, constricted at base. Inner dististyle, *id*, with a strong lobe on outer margin at base, separated from main body of style by a circular notch; rostrum of style long and narrow, blackened. Gonapophyses (Plate 3, fig. 33, *g*) with outer lobe flattened, broader than acute spine at base. Eighth sternite (Plate 3, fig. 33, 8*s*) with a conspicuous, pale, depressed, median lobe, as in *depressa*, this lobe about two and one-half times as long as wide, subtended on either side by obtuse shoulders.

Habitat.—Japan, Honshiu.

Holotype, male, Kamikochi, altitude 5,000 feet, July 26, 1939 (*Suenson*).

The nearest ally of the present fly is *Tipula* (*Oreomyza*) *depressa* Alexander, likewise from the Japanese Alps, which differs especially in the details of structure of the male hypopygium, as follows: Lateral tergal arms broad, apices entire and truncated; outer dististyle narrower on outer portion; inner dististyle with basal lobe very large and flattened, only a little less extensive than remainder of style, separated from main body of latter by a broadly oval notch; gonapophyses with posterior lobe narrow, at central portion narrower than blackened spines; lobe of eighth sternite shorter and more broadly obtuse at apex, length less than twice greatest width.

NEPHROTOMA ALTICRISTA sp. nov. Plate 1, fig. 8; Plate 3, fig. 34.

General coloration yellow, præscutum with three polished leaden stripes that are very narrowly bordered by brownish black, cephalic end of median stripe paling to reddish; scutellum and postnotum uniformly yellow; antennæ with flagellar segments rather strongly incised; wings subhyaline, stigma medium brown, extreme wing tip vaguely darkened; abdomen with tergites yellow, trivittate with black; terminal three segments black; male hypopygium relatively small; inner dististyle with dorsal crest very high and glabrous.

Male.—Length, about 13 to 14 millimeters; wing, 11 to 12; antenna, about 4.8 to 5.

Frontal prolongation of head yellow, outer end of dorsal surface, together with the elongate nasus, darkened; palpi pale brownish yellow. Antennæ relatively long; basal three segments yellow; fourth segment pale brown, base a little darker; succeeding segments black; flagellar segments rather strongly incised, subequal in length to longest verticils. Head orange, vertex with a delicate brown median line extending from summit of vertical tubercle to occiput; occipital brand concolorous with remainder of head.

Pronotum orange. Mesonotal præscutum orange yellow, with three polished lead-colored stripes that are very narrowly bordered by brownish black; cephalic third of median stripe paling to reddish; an opaque brownish-black spot laterad of anterior end of outer præscutal stripe; scutum yellow, lobes extensively lead-colored, narrowly bordered by brownish black; scutellum and postnotum uniformly orange yellow. Pleura yellow, scarcely variegated by areas of more orange yellow. Halteres with stem pale brown or brownish yellow, base of knob infuscated, apex paling to obscure yellow. Legs with coxæ and trochanters yellow; femora obscure yellow, tips very narrowly, vaguely darkened; tibiæ obscure yellow; tarsi passing into black. Wings (Plate 1, fig. 8) subhyaline; stigma medium brown; extreme wing tip vaguely darkened; outer wing veins insensibly seamed with brown; veins dark brown. Stigmal trichia about 30 to 35. Venation: Rs a little longer than basal section of R_5; cell M_1 variable, from short-petiolate to very narrowly to broadly sessile; m-cu at fork of M or on M_4 shortly beyond origin.

Abdominal tergites yellow, conspicuously trivittate with black; seventh and succeeding segments black, outer appendages pale brown to yellowish brown. Male hypopygium (Plate 3, fig. 34) with tergite, 9*t*, transverse, caudal margin with two submedian rounded lobes that are set with blackened points and separated by a narrow U-shaped notch; outer lobes appearing as pale ears, their cephalic mesal portions with small black spines. Outer dististyle, *od*, with apical fourth narrowed. Inner dististyle, *id*, with beak slender; dorsal crest very high and glabrous. Gonapophyses, *g*, appearing as small pale blades, about twice as long as width at base, tips obtuse. Ædeagus profoundly trifid at apex. Ninth sternite with a small, finger-like, median lobe. Eighth sternite, 8*s*, extensive, sheathing, caudal margin not or scarcely notched, median area pale and membranous, its outline indicated in the figure by dots.

Habitat.—China, Szechwan.

Holotype, male, Mount Omei, Shuang Fei Chiao, altitude 3,000 feet, June 14, 1935 (*Graham*). Paratopotypes, 4 males, June 14 to 22, 1935. Type in the United States National Museum.

Allied to *Nephrotoma decrepita* Alexander and *N. pilata* Alexander, differing in the coloration of the body and, especially, in the structure of the male hypopygium. In the present fly the uniformly yellow scutellum and postnotum suffice to distinguish the species from the above-mentioned allies.

NEPHROTOMA CIRCUMCINCTA sp. nov. Plate 1, fig. 9.

General coloration yellow, præscutum with four nacreous stripes that are narrowly but completely encircled by velvety black; scutal lobes similarly nacreous, the areas encircled by black; scutellum and postnotum yellow; pleura yellow, weakly variegated by brown areas; wings subhyaline, cell Sc and stigma more darkened; no stigmal trichia; cell M_1 broadly sessile; abdominal tergites yellow, with a very broad, continuous, median, brown stripe, lateral tergal borders and pleural region similarly darkened; sternites yellow.

Female.—Length, about 13 millimeters; wing, 12.5.

Frontal prolongation of head yellow; nasus distinct, scarcely darkened but provided with long black setæ; palpi dark brown, intermediate segments more brownish yellow, terminal segment brownish black. Antennæ with basal three segments yellow, the organ broken beyond this point. Head deep orange, central portion of vertex weakly more infuscated; vertical tubercle low; occipital brand very small, reduced to an equilateral triangle on the occiput itself.

Pronotum conspicuously dark brown on anterior half of scutum and along the lateral margins, broad posterior portion of scutum, entire scutellum, and pretergites yellow. Mesonotal præscutum yellow with four nacreous stripes that are narrowly but completely encircled by velvety black, the two inner margins of the intermediate stripes thus forming a continuous median stripe of twice the width; opposite the anterior ends of the lateral stripes the velvety black area is widely expanded toward the margin, almost reaching it, but the stripe itself is not deflected laterad; suture darkened; scutum with the median area broadly yellow, each lobe occupied by two confluent nacreous areas that are encircled by a common velvety-black ring; scutellum and parascutella testaceous yellow; postnotum

yellow, posterior border vaguely more grayish, this portion on lateral angles provided with microscopic setulæ. Pleura and pleurotergite almost uniformly yellow, anepisternum and ventral sternopleurite, with the meron, weakly darkened. Halteres brownish yellow, knob slightly more darkened. Legs with coxæ and trochanters yellow; femora yellow, extreme tips vaguely more darkened; tibiæ and proximal portion of basitarsi obscure yellow, remainder of tarsi passing into brown. Wings (Plate 1, fig. 9) subhyaline, cell Sc and stigma darker; veins brown. No stigmal setæ except on veins. Venation: Sc_1 weakly preserved; cell M_1 broadly sessile; m-cu joining M_4 just beyond its origin.

Abdominal tergites yellow, with a very broad, continuous, median, brown stripe, lateral borders and pleural region similarly darkened, leaving clear areas of the yellow ground on either side of the midstripe; subterminal segments more uniformly blackened; sternites more uniformly yellow. Ovipositor horn yellow; cerci straight, relatively stout, their ventral margins at base with microscopic setulæ.

Habitat.—Assam, Khasi Hills.

Holotype, female, Cherrapunji, altitude 4,000 feet, 1935 (*Sircar*).

The peculiar coloration of the thoracic notum will readily distinguish the present species from regional allies. In the Oriental fauna it is most like *Nephrotoma whiteheadi* Edwards and a few allied forms in the Malayan region. It is assumed that the nacreous præscutal stripes are normal, but since the unique type specimen is slightly teneral, these areas may change slightly in more fully colored individuals.

DOLICHOPEZA (OROPEZA) SAUTERI (Riedel).

Oropeza sauteri RIEDEL, Arch. für Naturgesch. pt. A 82 (1917) 114, 115.

Kuliang, Fukien Province, eastern China, 1,500 to 2,500 feet, April 10, 1938; 1,800 to 2,000 feet, May 11 to 30, July 1 to 7, 1937 (*Kellogg*). Hitherto known from Formosa.

CYLINDROTOMINÆ

CYLINDROTOMA ANGUSTIPENNIS sp. nov. Plate 1, fig. 10.

General coloration pale yellow, head and thorax conspicuously patterned with black, including three nearly confluent præscutal stripes; knobs of halteres blackened; legs black, femoral bases restrictedly pale; wings narrow with a weak dusky tinge, the narrow stigma brownish black; Sc relatively short, Sc_2 ending

opposite fork of Rs; Rs long, nearly straight; abdomen, including ovipositor, black.

Female.—Length, about 11 millimeters; wing, 9.5.

Rostrum yellow, weakly darkened above; palpi black. Antennæ black, proximal end of scape paler; flagellar segments subcylindrical, outer segments slenderer. Head light yellow, posterior vertex and occiput black, sending a narrow arm laterad and beneath onto genæ, posterior orbits remaining broadly pale.

Pronotum with scutum black, scutellum yellow. Mesonotal præscutum very pale yellow or whitish yellow, conspicuously patterned with three black stripes that are virtually confluent in front, leaving narrow, pale interspaces behind; scutum pale yellow, each lobe with a conspicuous black area on mesal portion; scutellum pale yellow; mediotergite pale yellow, posterior third brownish black. Pleura pale yellow, conspicuously variegated with black on the ventral sternopleurite, ventral anepisternum, and extreme ventral edge of pleurotergite. Halteres with stem brownish yellow, knob blackened. Legs with coxæ yellow, fore pair of coxæ weakly infuscated on basal half; trochanters yellow; remainder of legs black, with about basal third of femora obscure yellow. Wings (Plate 1, fig. 10) with a weak dusky tinge, the narrow stigma brownish black; veins beyond level of outer end of cell 1st M_2 very narrowly bordered with dusky, so the veins appear unusually stout; veins brownish black. Wings narrow compared with *distinctissima* or *japonica*. Venation: Rs long, nearly straight, not or scarcely arcuated at origin, nearly twice length of R_{2+3}; Sc_2 ending opposite fork of Rs; cell M_1 short-petiolate; m-cu at near one-third length of cell 1st M_2.

Abdomen black, lateral margins of basal tergite pale; pleural membrane yellow; ovipositor with valves intensely black.

Habitat.—China, Szechwan.

Holotype, female, Mount Omei, Yien Lao Dong Temple, altitude 6,500 feet, August 5, 1935 (*Graham*); United States National Museum.

In its general coloration the present species is most similar to *Cylindrotoma distinctissima* (Meigen) of the western Palæarctic Region, or *C. japonica* Alexander of the eastern Palæarctic Region, differing in the narrow wings, with blackened veins, and in the blackened legs. *C. nigripes* Alexander has the general coloration black-pruinose, with the yellow areas very restricted; wings with Rs arcuated at origin and with Sc long,

Sc_2 ending some distance beyond the level of r-m. As previously indicated, I am now doubtful that the antennæ associated with the type specimen of *nigripes* really belong to this fly. In the type the antennæ were detached and the association cannot be finally confirmed or refuted.

LIMONIINÆ

LIMONIINI

LIMONIA (DICRANOMYIA) POLI sp. nov. Plate 1, fig. 11; Plate 3, fig. 35.

Limonia (*Dicranomyia*) *fullowayi* ALEXANDER, Phil. Jour. Sci. 63 (1937) 373; *nec fullowayi* ALEXANDER, Can. Ent. 47 (1915) 79, 80.
Limonia (*Dicranomyia*) *fullowayi* ALEXANDER, Notes d'Ent. Chinoise (5) 4 (1937) 70.

Male.—Length, about 4.5 to 5.5 millimeters; wing, 5 to 6.

Rostrum black, gray-pruinose; palpi black. Antennæ black throughout; flagellar segments oval. Head dark gray.

Mesonotum chiefly dark gray, præscutum with a conspicuous brown median stripe; scutal lobes with their centers similarly darkened. Pleura dark gray. Halteres pale, knobs weakly infumed. Legs with coxæ dark basally, paling at outer ends; trochanters yellow; femora obscure yellow, tips weakly darkened; tibiæ and tarsi pale brown, outer tarsal segments a little darker. Wings (Plate 1, fig. 11) subhyaline, with a restricted spotted gray or brownish-gray pattern, including a more or less abundant series of small dots in cell C and the usual two spots in cell 1st A adjoining vein 2d A. Venation: Cell 1st M_2 subequal in length to longest vein beyond it; m-cu close to fork of M.

Abdominal tergites brownish black, basal and intermediate sternites pale brown or yellowish brown; hypopygium black. Male hypopygium (Plate 3, fig. 35) with tergite, 9*t*, rather deeply and narrowly notched medially. Ventral dististyle, *vd*, about one and one-half the total area of basistyle, *b;* rostral prolongation unusually long and slender, nearly straight; a single rostral spine, long and straight, placed about its own length from apex of prolongation. Gonapophyses, *g*, with mesal-apical lobe bidentate at apex.

Habitat.—Japan and China.

Holotype, male, Mount Omei, Szechwan, China, altitude 4,000 feet, July 14, 1931 (*Franck*). Paratypes, numerous specimens, Kuling, northern Kiangsi, China, altitude 3,250 feet, July 31 to August 18, 1935 (*Piel*), in Musée Heude, Shanghai; Hong San, southeastern Kiangsi, altitude 2,500 feet, July 15, 1936

(*Gressitt*); Mount Hakone, Honshiu, Japan, altitude 2,300 feet, July 12, 1923 (*Esaki*); Shibuya, near Komaba, Tokyo, Japan, June 7, 1920 (*Machida*); Mount Kirishima, Kiushiu, Japan, altitude 2,500 feet, May 3, 1929 (*Issiki*).

An unfortunate confusion of names concerning one of the commonest and most wide-spread crane flies in eastern Asia has resulted from insufficient knowledge concerning the identity of *Limonia* (*Dicranomyia*) *fullowayi* (Alexander). Recent accessions of material from the Caroline and other Pacific islands has shown that the fly identified as *fullowayi* as it occurs in Japan and China is not this species but an undescribed form most nearly allied to *L.* (*D.*) *punctulata* (de Meijere) of the Greater Sunda Islands, yet amply distinct. This latter fly has the spine of the rostrum of the male hypopygium strongly curved at tip and the armature of the gonapophyses quite distinct.

LIMONIA (DICRANOMYIA) RETROGRADA sp. nov. Plate 1, fig. 12; Plate 3, fig. 36.

General coloration brownish gray, præscutum with a conspicuous, brownish-black, median stripe; antennæ black throughout; halteres with knobs black; wings yellowish, oval stigma dark brown; Sc_1 terminating opposite origin of Rs, Sc_1 long; male hypopygium relatively large and complex in structure; tergite narrowly transverse, with a median tubercle bearing about six long setæ; basistyle with ventromesal lobe large, boat-shaped; ventral dististyle small, white, its rostral prolongation abruptly blackened, long and slender, gradually narrowed outwardly; rostral spines two, placed on basal third of prolongation; ædeagus narrow.

Male.—Length, about 7.5 millimeters; wing, 8.

Rostrum and palpi dark brown. Antennæ black throughout; flagellar segments oval. Head brownish gray; anterior vertex relatively wide.

Pronotum brown above, paler laterally. Mesonotal præscutum brownish gray, with a conspicuous, brownish-black, median stripe, the lateral stripes scarcely indicated; posterior sclerites of notum brownish gray. Pleura heavily gray-pruinose. Halteres with stem obscure yellow, knob black. Legs with coxæ yellow, fore pair of coxæ weakly darkened basally; trochanters yellow; femora brownish yellow, clearer basally, tips narrowly brownish black; tibiæ and basitarsi brown, tips narrowly blackened; remainder of tarsi black. Wings (Plate 1, fig. 12) with a yellowish tinge, the oval stigma dark brown, conspicuous; veins

dark brown. Venation: Sc_1 ending opposite origin of Rs, Sc_2 far from its tip; free tip of Sc_2 and R_2 in approximate transverse alignment; m-cu at fork of M.

Abdominal tergites blackened, paler laterally, caudal borders more narrowly pale; basal sternites yellow, outer segments darker; hypopygium black, outer lobe of ventral dististyle conspicuously white. Male hypopygium (Plate 3, fig. 36) with tergite, 9*t*, very narrowly transverse, caudal margin gently emarginate, lateral lobes thus very low but indicated by thickenings provided with setæ; a smaller median tubercle bearing six or seven very long setæ. Basistyle, *b*, entirely black, very small, its outer face with unusually few setæ; ventromesal lobe very large and conspicuous, boat-shaped. Dorsal dististyle a gently curved blackened rod, tip acute. Ventral dististyle, *vd*, small, its area much less than that of the total basistyle; outer whitened lobe oval; rostral prolongation and its basal enlargement abruptly black; prolongation a slender blade that very gradually narrows outwardly, tip acute, along margin with five or six equally spaced setæ; rostral spines broken in the unique type, only their bases remaining, place close together on the basal third of the prolongation, directed outwardly; basal enlargement of prolongation with conspicuous pencils and brushes of elongate setæ. Gonapophyses, *g*, with mesal-apical lobe gently curved at tip. Ædeagus, *a*, unusually slender, constricted at and before midlength, distal end very weakly expanded, terminating in two parallel lobes that are separated by a linear slit.

Habitat.—China, Szechwan.

Holotype, male, Tatsienlu, October 31, 1938 (*Franck*); caught on table, all its movements being either backward or to one side, not forward.

Limonia (*Dicranomyia*) *retrograda* is still another of the now numerous Asiatic species of the subgenus having a complex male hypopygium. It differs from all other generally similar regional species, as *L.* (*D.*) *gracilirostris* Alexander, *L.* (*D.*) *grahamiana* Alexander, *L.* (*D.*) *tseni* Alexander, and *L.* (*D.*) *veternosa* Alexander, in the structure of the male hypopygium. The most similar of these species, based on the structure of the hypopygium, is *gracilirostris*, which has this organ quite distinct in every detail. The habit of walking of the adult fly, as described by Franck, is relatively common among members of the various subgenera of *Limonia*.

LIMONIA (LIMONIA) NEONEBULOSA Alexander.

Dicranomyia nebulosa ALEXANDER, Can. Ent. 45 (1913) 203–205, preoccupied.

Limonia neonebulosa ALEXANDER, Phil. Jour. Sci. 24 (1924) 555, 556.

China, Chekiang: Hills south of Ningpo, halfway to Nimrod Sound, May 1 to 4, 1925 (*Suenson*); Szechwan, Mount Omei, altitude 4,000 feet, August 13, 1931 (*Franck*). Wide-spread in Japan and China.

HELIUS (HELIUS) NIPPONENSIS (Alexander).

Rhamphidia nipponensis ALEXANDER, Can. Ent. 46 (1914) 207–209.

China, Chekiang: Hills south of Ningpo, halfway to Nimrod Sound, May 1, 1925 (*Suenson*). One male, Hang-chow, April 28, 1924 (*Suenson*). Hitherto known from Japan.

HELIUS (HELIUS) PLUTO Alexander.

Helius (*Helius*) *pluto* ALEXANDER, Phil. Jour. Sci. 49 (1932) 118, 119.

China, Szechwan, Kwanhsien, altitude 3,500 feet, July 25 to August 1, 1937; Pehluting, altitude 6,000 feet, July 9, 1937 (*Franck*). Not included in the Wu Catalogue of Chinese Diptera (1940).

ORIMARGA (ORIMARGA) FOKIENSIS sp. nov. Plate 1, fig. 13; Plate 4, fig. 37.

General coloration dark plumbeous gray; antennæ and legs black; halteres with knob weakly darkened; wings relatively broad, brownish gray, stigmal region very narrowly darker brown; macrotrichia of veins beyond cord sparse; Sc_1 ending about opposite four-fifths length of Rs, Sc_2 at its tip, free tip of the latter atrophied; R_{1+2} and R_2 subequal in length, shorter than R_{2+3}; anal cells large; abdomen brownish black; male hypopygium with outer dististyle unusually short, apex blackened, shorter than pendant free tip of inner style; gonapophyses very slender, pale, narrowed to an acute point.

Male.—Length, about 6 millimeters; wing, 5.

Female.—Length, about 6.5 millimeters; wing, 5.3.

Rostrum and palpi black. Antennæ black throughout. Head black, heavily gray-pruinose, broad anterior vertex more silvery.

Mesonotal præscutum dark plumbeous gray, humeral and lateral portions somewhat clearer gray; posterior sclerites of notum gray, posterior border of scutellum narrowly more brownish yellow. Pleura black, pruinose, posterior sclerites and dorsopleural membrane somewhat brightened. Halteres with stem

pale, knob weakly darkened. Legs with coxæ light brown, fore pair of coxæ darker; trochanters brown; remainder of legs black. Wings (Plate 1, fig. 13) relatively broad, especially in male, brownish gray; stigmal region very narrowly darker brown; prearcular field and basal portions of costal region more whitened; veins pale brown, those in prearcular field still lighter. Macrotrichia of veins beyond cord sparse, there being scattered series on distal sections of veins R_3 to M_3, inclusive; costal fringe moderately long and abundant. Venation: Sc_1 ending about opposite four-fifths length of Rs, Sc_2 at its tip, free tip of latter atrophied; R_{1+2} and R_2 subequal in length, both shorter than R_{2+3}; basal section of R_{4+5} very strongly arcuated to angulated; petiole of cell M_3 varying from about one-half to more than two-thirds length of cell; anal cells very large and ample, due to the unusually broad wings. The type male shows an adventitious crossvein in cell R_3 of the right wing, in direct transverse alignment with r-m and immediately distad of R_2.

Abdomen brownish black, hypopygium a trifle brighter. Male hypopygium (Plate 4, fig. 37) with dististyle, *d*, unusually short, apex of outer style shorter than free portion of inner style, narrowly blackened and terminating in a short, acute point; inner style with its free apex pendant, with numerous long setæ. Basistyle, *b*, without lobes of any type. Phallosome with apophyses, *g*, very slender, pale, apex narrowed to an acute point.

Habitat.—China, Fukien.

Holotype, male, Kuliang, altitude 1,800 to 2,000 feet, June 1 to 3, 1937 (*Kellogg*). Allotopotype, female, with the type.

Orimarga (*Orimarga*) *fokiensis* is closest to species such as *O.* (*O.*) *griseipennis* Alexander (Formosa) and *O.* (*O.*) *gymnoneura* Alexander (Formosa), differing from both in the shape of the wing and in the details of venation. In wing shape the present fly is about intermediate between the two species mentioned, with the venational details correspondingly modified. The male of *griseipennis* is still unknown, but the hypopygium of *gymnoneura* is quite different from that of the present fly.

DICRANOPTYCHA SUENSONIANA sp. nov. Plate 1, fig. 14; Plate 4, fig. 38.

General coloration of mesonotal præscutum dark brown, the usual three stripes confluent to form a discal area; posterior sclerites of notum and pleura pruinose; intermediate flagellar segments weakly bicolored; halteres pale yellow; legs yellow,

extreme tips of femora, tibiæ, and basitarsi blackened; wings brownish yellow, costal border conspicuously light yellow; veins dark brown, veins in prearcular and costal fields light yellow; costal fringe short; basal section of R_{4+5} almost in direct longitudinal alignment with Rs; abdomen black, sparsely pruinose, hypopygium abruptly yellow; male hypopygium with outer dististyle flattened, very densely covered with setæ, lower surface before apical spine with blackened tubercles and short triangular spines; phallosome appearing as two pairs of elongate elements, longest pair appearing as acutely pointed blades, before apex on outer margin with a tiny spine.

Male.—Length, about 8.5 to 9 millimeters; wing, 10 to 10.5.

Female.—Length, about 9 to 10 millimeters; wing, 9.5 to 10.5.

Rostrum black, pruinose; palpi black. Antennæ with basal segments yellow, intermediate and outer segments weakly bicolored, incisures and especially bases of segments yellow, central portion infuscated; outer segments more uniformly infuscated; flagellar segments subcylindrical, passing into elongate-oval. Head black, heavily gray-pruinose; anterior vertex a little less than twice diameter of scape.

Pronotum gray. Mesonotum chiefly dark brown, heavily pruinose, especially posterior sclerites of notum; præscutum with disc almost occupied by a subnitidous dark-brown shield, the three usual stripes being confluent; pseudosutural foveæ black. Pleura heavily gray-pruinose. Halteres pale yellow. Legs with coxæ yellow, weakly pruinose; trochanters yellow; femora, tibiæ, and basitarsi yellow, extreme tips of segments blackened; remainder of tarsi passing into brownish black. Wings (Plate 1, fig. 14) brownish yellow, costal border conspicuously light yellow; veins dark brown, veins in prearcular and costal fields light yellow. Costal fringe short in both sexes. Venation: Basal section of R_{4+5} almost in direct alignment with Rs, R_{2+3} erect at origin; Rs about one and one-half as long as cell 1st M_2.

Abdomen black, sparsely pruinose, hypopygium abruptly yellow. Male hypopygium (Plate 4, fig. 38) with interbases appearing as slender, pale rods, a little expanded distally, their extreme tips obtuse and decurved. Outer dististyle, *od*, narrowed to acute blackened apical spine, rather broadly flattened, entire outer surface with very numerous erect setæ, lateral and ventral portions with conspicuous, erect, blackened tubercles

and short triangular spines. Inner dististyle, *id*, longer, gradually narrowed to obtuse tip. Phallosome consisting of two pairs of elongate elements, the longest pair appearing as flattened blades that diverge gradually, narrowed to the acute spinous tips, before apex on outer margin with a very tiny spine. Shorter apophyses, *g*, with apex bent mesad at a right angle into long, very pale points that bear numerous long pale setæ.

Habitat.—Japan, Honshiu.

Holotype, male, Kawaguchi, Fuji Lakes District, altitude 2,800 feet, August 11, 1939 (*Suenson*). Allotopotype, female. Paratopotypes, 1 male, 4 females.

I take great pleasure in dedicating this distinct fly to the collector, Mr. E. Suenson, of Shanghai, to whom I am greatly indebted for many Tipulidæ from Japan and eastern China. *Dicranoptycha suensoniana* is closest to *D. prolongata* Alexander, of northern Korea, and to *D. venosa* Alexander, of Saghalien, differing conspicuously from both in the body coloration and especially in the structure of the male hypopygium.

DICRANOPTYCHA MALABARICA sp. nov. Plate 1, fig. 15; Plate 4, fig. 39.

General coloration of thorax brownish yellow, pleura clearer yellow; antennæ obscure yellow, outer segments passing into brown; legs yellow, extreme tips of femora, tibiæ, and basitarsi blackened; wings brownish yellow, prearcular and costal fields clear yellow; veins deep yellow to brownish yellow; costal fringe of moderate length, dense; R_{1+2} relatively long, exceeding m-cu in length; abdomen brownish yellow with a narrow, brownish-black, subterminal ring in male, this ring chiefly involving the eighth tergite; male hypopygium with outer dististyle relatively weak, with delicate setulæ and appressed spinous points; apex of inner dististyle dilated; phallosome a complex mass consisting of a dorsal and a ventral portion separated from one another by a distinct notch.

Male.—Length, about 7.5 to 8 millimeters; wing, 7.5 to 8.

Female.—Length, about 7.5 to 8 millimeters; wing, 7 to 7.5.

Rostrum obscure yellow; palpi light brown. Antennæ obscure yellow, outer segments passing into brown. Head brownish yellow to light brown, more pruinose beneath; anterior vertex somewhat wider than diameter of scape.

Mesonotum brownish yellow, surface, especially of præscutum, subnitidous. Pleura clearer yellow. Halteres pale yellow throughout. Legs with coxæ and trochanters yellow; femora, tibiæ, and basitarsi light yellow, tips very narrowly but con-

spicuously blackened; remaining tarsal segments passing into brown. Wings (Plate 1, fig. 15) with a brownish-yellow tinge, prearcular and costal fields clear yellow; veins deep yellow to brownish yellow. Costal fringe (male) dense and of moderate length. Venation: Rs subequal to or shorter than cell 1st M_2; R_{1+2} relatively long, exceeding m-cu in length.

Abdomen brownish yellow, sternites somewhat clearer; in male eighth segment and adjoining portions of seventh and ninth brownish black to form a narrow subterminal ring; hypopygium yellow. Male hypopygium (Plate 4, fig. 39) with outer dististyle, *od*, relatively small and slender, with abundant short, erect setulæ and a few scattered appressed spinous points. Inner dististyle, *id*, much longer, at apex dilated into a discoid head, the whole surface with abundant coarse setæ from conspicuous punctures. Interbase, *i*, a pale, flattened blade, only slightly expanded at distal end, base greatly prolonged to opposite cephalic end of phallosome; apex of interbase with a slightly projecting point. Phallosome, *p*, massive, apex obtuse and provided with abundant delicate setulæ; apex with a broadly circular orifice, margin darker and more sclerotized, in central portion with two small teeth; a shorter portion of phallosome weakly bilobed at apex.

Habitat.—South India, Malabar.

Holotype, male, Walayar Forest, altitude 2,000 feet, August 8, 1938 (*Susai Nathan*). Allotopotype, female, in copula with type. Paratopotypes, 30 males and females, altitude 2,000 feet, August 8, 1938, altitude 1,500 feet, September 9, 1938; paratype, 1 female, Siruvani, Coimbatore District, altitude 3,000 feet, August 11, 1938 (*Susai Nathan*).

Dicranoptycha malabarica is the first species of the genus to be described from India. There are several members of *Dicranoptycha* in tropical Africa and numerous others in China and Japan, so the occurrence in southern India was not unexpected.

PEDICIINI

DICRANOTA (EUDICRANOTA) RADIALIS sp. nov. Plate 1, fig. 16.

General coloration yellow; antennæ 15-segmented, flagellar segments short and crowded, especially the basal ones; mesonotal præscutum and scutal lobes caseous; tips of tibiæ and proximal two tarsal segments narrowly dark brown; wings whitish subhyaline, very sparsely patterned with brown, appearing as small and narrow seams on certain of the veins; Rs long, angulated at origin; a supernumerary crossvein in cell

R_1 at near one-third length of Rs, additional to usual crossvein lying beyond midlength of cell; R_2 very oblique, ending in costa or barely connected at its tip with R_1; m-cu just beyond fork of M.

Female.—Length, about 7 millimeters; wing, 6.8.

Rostrum and palpi yellow. Antennæ short, yellow throughout, 15-segmented; flagellar segments short and crowded, basal segments not narrowed apically and thus joined broadly with succeeding segments; outer segments more oval, with longer verticils. Head pale yellow.

Pronotum pale yellow. Mesonotal præscutum and scutal lobes pale grayish brown or caseous, median region of scutum, scutellum, and postnotum yellow; setigerous punctures of præscutum conspicuous. Pleura pale yellow. Halteres yellow. Legs relatively stout, yellow, tips of tibiæ and proximal two tarsal segments narrowly dark brown, remainder of tarsi uniformly dark brown. Wings (Plate 1, fig. 16) whitish subhyaline, very sparsely patterned with brown, appearing as small and narrow seams on Sc_2, origin of Rs, along both supernumerary crossveins in cell R_1, along R_2, and less evidently along cord and outer end of cell 1st M_2; a distinct grayish marginal cloud at end of vein R_3; veins beyond cord chiefly dark brown, veins basad of cord and in costal region yellow except where traversing dark areas. Venation: Sc_2 lying far basad, distance between arculus and vein only equal to cell 1st M_2; Rs long, angulated and sometimes spurred at origin, with a strong supernumerary crossvein at near one-third its length in cell R_1, as well as the usual *"Dicranota"* crossvein farther distad, about opposite fork of R_{4+5}; a weaker crossvein at near one-third length of cell R_3; vein R_2 very oblique, ending in costa beyond tip of R_1 or barely fused with this vein; vein R_3 unusually short and upcurved at its outer end, a little exceeding twice length of vein R_2; cell M_1 a little exceeding its petiole; m-cu shortly beyond fork of M.

Abdomen obscure yellow; cerci long and powerful, yellowish horn-colored.

Habitat.—Manchuria, Kirin.

Holotype, female, Kaolingtzu, June 20, 1940 (*Weymarn*).

Dicranota (*Eudicranota*) *radialis* is closest to *D.* (*E.*) *perdistincta* Alexander, of northern Korea. I must regard the strong crossvein connecting vein R_1 with Rs as a supernumerary rather than an adventitious element and thus furnishing a marked

specific character for the separation of the two species. Whether the further crossvein in cell R_3 is also supernumerary cannot be affirmed. The larger size, more fully developed wings, and caseous color of the præscutum give a distinctive appearance to the present fly. In *perdistincta,* and presumably also in *radialis,* the halteres of the female are shorter than those of the male.

HEXATOMINI

LIMNOPHILA (ELÆOPHILA) LATINIGRA sp. nov. Plate 1, fig. 17; Plate 4, fig. 40.

General coloration gray, præscutum with six broken series of brown spots and dots; antennal flagellum bicolored; pleura gray, conspicuously patterned with dark brown; base of knob of haltere whitish; femora yellow, tips very broadly black, including approximately one-fifth total length of segment; wings whitish, with a heavy brown spotted and dotted pattern; abdomen brownish black, hypopygium brightened; male hypopygium with apical portion of outer dististyle almost central in position, apex a right-angled spine subtended on either side by conspicuous lobes; ædeagus very small, on either side with a small, acute, triangular point.

Male.—Length, about 5.5 millimeters; wing, 6.

Rostrum black, sparsely pruinose; palpi black. Antennæ with basal two segments black, sparsely pruinose; succeeding segments bicolored, their bases black, the apical half or less yellow, the amount of latter decreasing on outer segments; terminal segments uniformly black; basal flagellar segments elongate, outer segments shorter. Head gray, center of vertex chiefly dark brown.

Thoracic notum gray, variegated with short brown dashes, including a central dash on pronotum and six broken series on præscutum, representing the usual stripes and interspaces; tuberculate pits and pseudosutural foveæ black; scutum gray, each lobe with two separate dark-brown areas; scutellum narrowly transverse, dark gray, parascutella darker; mediotergite gray, lined with darker. Pleura gray, conspicuously patterned with dark brown, including two irregular and partly broken longitudinal stripes. Halteres with base of stem yellow, remainder brown; base of knob whitish, apex dark brown. Legs with coxæ dark brown, gray-pruinose; trochanters black; femora yellow, tips broadly and abruptly jet black, the amount involving about one-fifth the total length of segment; tibiæ yellow, tips narrowly blackened; tarsi obscure yellow, apices of

basitarsi and all of outer segments darkened. Wings (Plate 1, fig. 17) only moderately widened in male, broadest at or just before midlength; ground color whitish, extreme wing base more yellowed; a very abundant dark-brown spotted and dotted pattern; major dark areas at arculus; as a narrow complete band at level of origin of Rs and supernumerary crossvein, ending at outer end of cell 2d A a short distance before vein 2A; a dark V with the point on the anterior cord, the arms at fork of Sc and the stigma; wing tip darkened, broken by abundant small dots; all cells with abundant small brown dots; veins yellow, infumated in darkened areas. Venation: Sc_1 ending just before fork of Rs, Sc_2 at its tip; R_2 subequal to R_{2+3}; R_{2+3+4} in longitudinal alignment with Rs; m-cu about two-thirds its length beyond fork of M.

Abdomen brownish black, sparsely pruinose; hypopygium brightened. Male hypopygium (Plate 4, fig. 40) with outer dististyle, *od,* broad, apical point almost central in position, at apex strongly curved to a right angle; outer shoulder an acutely pointed flange, inner lobe more obtusely rounded; setæ on face of style sparse. Inner dististyle, *id,* pale, subobtuse at apex. Phallosome, *p,* with ædeagus very small, subtended on either side by a small, acute, triangular point.

Habitat.—China, Fukien.

Holotype, male, Kuliang, altitude 1,500 to 2,500 feet, April 6 to 13, 1938 (*Kellogg*).

Limnophila (*Elæophila*) *latinigra* is most similar to species such as *L.* (*E.*) *dietziana* Alexander and *L.* (*E.*) *suensoni* Alexander, differing conspicuously in the very broad blackened femoral tips and, especially, in the distinctive structure of the male hypopygium.

LIMNOPHILA (ELÆOPHILA) SIMILISSIMA sp. nov. Plate 4, fig. 41.

General coloration gray, præscutum variegated with short, dark-brown lines; basal flagellar segments yellow; femora yellow, tips broadly blackened, on outer face close to apex more reddish brown; wings (male) dilated, widest before tip of vein 2d A; whitish, heavily spotted and dotted with brown; male hypopygium with outer dististyle narrow, subtended on outer face by a relatively slender lobe, its tip narrowly obtuse; ædeagus with subtending lobes low and obtuse.

Male.—Length, about 5.5 millimeters; wing, 6.2.

Rostrum and palpi black. Antennæ with scape and pedicel black; basal flagellar segments uniformly yellow, outer segments

darker; flagellar segments oval. Head brownish gray, sparsely patterned with darker.

Pronotum gray, with a delicate median brown line. Mesonotal præscutum gray with short, dark-brown lines, representing the usual stripes, with additional dashes on posterior interspaces; scutum gray, each lobe with two brown areas; scutellum gray, with a narrow brown median line that likewise includes the central area of scutum; postnotum gray, mediotergite darkened behind and on sides. Pleura conspicuously variegated with dark brown on a gray ground. Halteres dark brown, base of stem restrictedly pale, extreme tip of stem slightly brightened. Legs with coxæ gray; trochanters blackish; femora yellow, tips broadly blackened, outer face close to apex more reddish; tibiæ yellow, tips very weakly infuscated; basal tarsal segments yellow, extreme tips vaguely darkened; outer tarsal segments uniformly darkened. Wings of male dilated, widest just basad of vein 2d A; ground color whitish, heavily patterned with brown spots and dots; major brown areas at and just beyond arculus; as a narrow broken band at level of origin of Rs and supernumerary crossvein, interrupted in cell Cu; a large V-shaped area with arms at fork of Sc and stigma, converging to a point behind, enclosing a very narrow ground area between branches; wing tip broadly and almost solidly darkened; numerous small dots in interspaces; veins pale, brown in clouded areas. Venation: Sc_1 ending a short distance beyond fork of Rs, Sc_2 at its tip; R_{2+3+4} in longitudinal alignment with Rs, the latter square and short-spurred at origin; m-cu at near midlength of the small cell 1st M_2.

Abdomen dark brown, hypopygium a trifle brightened. Male hypopygium (Plate 4, fig. 41) with outer dististyle, *od,* narrow, subtended on outer face by a relatively slender lobe or flange, apex narrowly obtuse; apical spine gently curved to acute tip, on inner face gradually sloping. Inner dististyle, *id,* entirely pale. Phallosome, *p,* with ædeagus relatively large and conspicuous, lateral subtending lobes low and obtuse.

Habitat.—China, Szechwan.

Holotype, male, Mount Omei, Flying Bridges, altitude 3,000 feet, June 1, 1938 (*Tsen*).

Limnophila (*Elæophila*) *similissima* is very like the Japanese *L.* (*E.*) *dietziana* Alexander, differing in the nature of the wing and leg pattern and especially in the details of structure of the male hypopygium. It is quite distinct from the only

other species of *Elæophila* hitherto made known from western China.

LIMNOPHILA TRANSITORIA sp. nov. Plate 1, fig. 18; Plate 4, fig. 42.

Allied to *nemoralis;* general coloration light gray, præscutum with very slightly darker-gray stripes; basal antennal segments pale; wings with a strong brownish-yellow tinge, stigmal region very slightly darker brown; cell M_1 lacking; abdominal tergites light brown, subterminal segments forming a blackened ring; male hypopygium with interbases only feebly expanded at outer ends.

Male.—Length, about 5 to 6 millimeters; wing, 5.8 to 6.8.

Rostrum brown, pruinose; palpi black. Antennæ short; scape pruinose; succeeding two or three segments brownish yellow, outer segments passing into brown; flagellar segments elongate, verticils long and conspicuous. Head light gray; anterior vertex broad.

Pronotal scutellum yellow. Thoracic dorsum light gray, præscutal stripes very slightly darker gray, only slightly differentiated against ground. Pleura chiefly pale, gray-pruinose, ventral sternopleurite and dorsopleural region darker gray. Halteres yellow. Legs with coxæ testaceous yellow to brownish yellow; trochanters yellow; femora yellowish brown, slightly darkened on outer portion; remainder of legs obscure yellow to brownish yellow, terminal tarsal segments blackened. Wings (Plate 1, fig. 18) with a strong brownish-yellow tinge, stigmal region very slightly darker brown; veins brownish yellow to very pale brown. Venation: Cell M_1 lost by fusion to margin of veins M_1 and M_2; m-cu beyond fork of M, the distance variable, in cases only a little less than vein itself.

Abdominal tergites light brown, sternites obscure yellow or brownish yellow; subterminal segments, including seventh and eighth, forming a blackened ring; hypopygium yellow. Male hypopygium (Plate 4, fig. 42) with outer dististyle, *od,* unequally bifid at apex, inner or lower tooth longer and stouter. Interbase, *i,* only feebly expanded at outer end.

Habitat.—Japan, Honshiu.

Holotype, male, Kamikochi, altitude 5,000 feet, June 19, 1939 (*Suenson*). Paratopotypes, 4 males, June 18 and 19, 1939.

Among the described regional species of the *nemoralis* group the present fly is closest to *Limnophila subnemoralis* Alexander, of Japan. The described species of the group, including the western Palæarctic *L. adjuncta* Walker, and *L. nemoralis*

(Meigen) and its described races, *minuscula* Edwards, *separata* Walker, and *quadrata* Edwards; the eastern Palæarctic and Oriental *L. inæqualis* Alexander, *L. nesonemoralis* Alexander, and *L. subnemoralis* Alexander; and the Nearctic *L. brevifurca* Osten Sacken and *L. occidenta* Alexander, all have cell M_1 present but in cases very small and with abnormal individuals showing the cell lost by fusion of veins in one or even in both wings. The present series indicates that the character of loss of cell M_1 in the present species is a constant one. The case is comparable to that found in *Pseudolimnophila noveboracensis* (Alexander) and others where cell M_1 is lacking, although it is present in numerous allied species of the genus.

HEXATOMA (ERIOCERA) COOMANI sp. nov. Plate 1, fig. 19.

Belongs to the *chirothecata* group; mesonotal præscutum dark brown, with four shiny blue-black stripes that are narrowly margined with velvety black; posterior sclerites of notum and abdomen black; halteres and legs black throughout; wings with a strong brown tinge, costal border with a more yellowish cast; R_{1+2} long; cells M_1 short; m-cu at near midlength of the small cell 1st M_2.

Male.—Length, about 13 millimeters; wing, 10.

Rostrum black, sparsely pruinose; palpi black. Antennæ with scape and pedicel black; flagellum broken. Head black, very sparsely pruinose; anterior vertex wide, approximately four times diameter of scape.

Pronotum black, sparsely pruinose. Mesonotal præscutum dark brown with four shiny blue-black stripes that are narrowly margined with velvety black, pruinose portions with long, black setæ; posterior sclerites of notum black, surface subnitidous. Pleura black, surface pruinose, opaque; dorsopleural membrane dark. Halteres black throughout. Legs with coxæ black-pruinose; trochanters black; remainder of legs black; claws (male) with a strong basal tooth. Wings (Plate 1, fig. 19) with a strong brown tinge, base and costal region more suffused, with a yellowish cast especially in cells C and Sc; stigma lacking; veins brown. Outer radial veins with numerous trichia; outer branches of M without trichia except on M_1 and M_2. Venation: Sc long, Sc_1 ending shortly beyond R_2, Sc_2 far from its tip, lying just before fork of R_{2+3+4}; R_{1+2} long, approximately one-half Rs; R_{2+3+4} long, nearly twice basal section of R_5; outer medial veins very delicate and faint; cell M_1 small, only about one-half as long as its petiole, fork asymmetrical, with M_1

arcuated, M_2 in longitudinal alignment with M_{1+2}; cell 1st M_2 relatively small, subequal in length to vein M_4 beyond it, m-cu at near middle of its length.

Abdomen, including hypopygium, polished black.

Habitat.—French Indo-China, Tonkin.

Holotype, male, Hoa-binh (*Cooman*); Musée Heude.

This distinct species is named in honor of the collector, Mr. A. de Cooman. By Edwards's key to the Old World species of *Eriocera*[2] the present fly runs to couplet 37, disagreeing with all species in the *chirothecata* group, coming closest to the otherwise entirely distinct *H.* (*E.*) *waterstoni* (Edwards), of Macedonia.

HEXATOMA (ERIOCERA) TONKINENSIS sp. nov. Plate 1, fig. 20.

Belongs to *pyrrhochroma* group; general coloration of thorax orange, without markings except a small brown spot on dorsal mesepisternum before wing root; antennal scape yellow, pedicel and flagellum black; legs brown, femoral bases restrictedly obscure yellow; wings with a brown tinge, costal field more saturated; stigma small, dark brown; cell M_1 longer than its petiole; m-cu at near one-third length of cell 1st M_2; abdomen, including hypopygium, orange.

Male.—Length, about 10 millimeters; wing, 11.5 antenna, about 1.8.

Rostrum brownish yellow; palpi black. Antennæ short, 8-segmented; scape yellow, pedicel and flagellum black; flagellar segments elongate, gradually decreasing in length; terminal segment about one-half length of penultimate. Head orange; vertical tubercle low.

Prothorax and mesothorax uniformly deep orange, præscutum glabrous; a single brown spot on extreme dorsal portion of anepisternum in front of wing root. Halteres with stem brownish yellow, knob brownish black. Legs with coxæ orange; trochanters obscure yellow; femora dark brown, bases restrictedly obscure yellow; tibiæ and tarsi dark brown; claws (male) toothed. Wings (Plate 1, fig. 20) narrow, with a brownish tinge, prearcular and costal fields still darker brown; stigma very small and narrow, dark brown; vague dark seams along certain of the veins, including Rs and Cu; cell Sc yellow; veins brown. Abundant macrotrichia on veins beyond cord, except for distal section of Cu_1. Venation: Sc_1 ending just

[2] Ann. & Mag. Nat. Hist. (9) 8 (1921) 70–78.

beyond fork of R_{2+3+4}, Sc_2 some distance from its tip, shortly beyond fork of Rs; cell M_1 longer than its petiole; m-cu at near one-third length of cell 1st M_2, latter about twice as long as wide.

Abdomen, including hypopygium, orange, pleural region vaguely darker.

Habitat.—French Indo-China, Tonkin.

Holotype, male, Laokay, August 13, 1934 (*C. Brownell*); Lingnan University.

Most nearly related to *Hexatoma* (*Eriocera*) *nigronotata* Alexander, of Mindanao, and to *H.* (*E.*) *quadriatrata* Alexander, of southeastern China, differing in the coloration of the body and wings, and in the details of venation. The dark pattern of the mesothorax is here limited to a small brown spot on the dorsal mesepisternum.

ERIOPTERINI

GONOMYIA (LIPOPHLEPS) BIMUCRONATA sp. nov. Plate 1, fig. 21; Plate 4, fig. 43.

Belongs to the *incompleta* group; antennæ black, relatively elongate, in male segments with a dense, erect, white pubescence but without elongate verticils; mesonotum grayish brown, variegated with yellow on scutellum and median region of scutum; posterior pleurites yellow; legs brown; wings tinged with brown; Sc short; male hypopygium with a single bispinous dististyle, second spine shorter and placed on concave margin of style.

Male.—Length, about 2.5 millimeters; wing, 3.2.

Rostrum obscure orange; palpi dark brown. Antennæ (male) brownish black throughout, relatively elongate for a member of this subgenus; flagellar segments subcylindrical to fusiform, with a dense, erect, white pubescence but without elongate verticils, these being only about one-half length of segment. Head dark.

Anterior pretergites light yellow. Mesonotal præscutum and scutal lobes uniformly dark grayish brown, humeral region of præscutum restrictedly brightened; median region of scutum, posterior borders of scutal lobes, and broad apical margin of scutellum yellow; base of scutellum and adjoining portions of scutum darkened; mediotergite dark brown, sparsely pruinose. Pleura chiefly light yellow, including posterior sternopleurite, pteropleurite, meral region, and pleurotergite, ventral sternopleurite, and anepisternum somewhat darker. Halteres pale, knobs weakly darkened. Legs with fore coxæ darkened, re-

maining coxæ and all trochanters somewhat more testaceous; remainder of legs brown, femoral bases scarcely brightened. Wings (Plate 1, fig. 21) with a brownish tinge, prearcular region and cells C and Sc pale yellow; stigma diffuse, darker brown than ground; veins brown. Venation: R_{1+2} reaching costa but without trichia on extreme outer portion; Sc short, Sc_1 ending shortly before origin of Rs, latter shorter than its anterior branch; cell R_5 very strongly narrowed at outer end; m-cu at fork of M; cell 2d A wide.

Abdomen brown, sternites very little brighter; hypopygium obscure yellow. Male hypopygium (Plate 4, fig. 43) with dististyles, *d*, symmetrical. Outer lobe of basistyle, *b*, stout, extending about to opposite level of apex of dististyle. Dististyle, *d*, conspicuously bispinous, outer spine longer, slenderer, gently curved; second spine on concave margin at near midlength of style; surface of style with setigerous punctures, as figured. Phallosome, *p*, of the general type, of the *incompleta* group, terminal bilobed portion very narrow at base.

Habitat.—Philippines, Luzon.

Holotype, male, Batangas Province, Balayan, August 25, 1932 (*Rivera*).

Gonomyia (*Lipophleps*) *bimucronata* is most nearly allied to *G.* (*L.*) *incompleta* Brunetti (Japan to British India), differing markedly in the structure of the male hypopygium. The phallosome is much alike in all members of the group but the dististyles show unusually strong characters. In *incompleta* the dististyle is slender, prolonged into a slender apical spine, with a small tubercle or weak spine on the outer or convex face at base of spine. There is a slight difference in the dististyles of the two sides in *incompleta* but nothing to approach the asymmetry found in the allied *G.* (*L.*) *inaequistyla* Alexander (Mindanao to Celebes). In the other two Philippine members of the group, *G.* (*L.*) *maquilingia* Alexander and the present fly, the dististyles of the two sides are entirely alike.

GONOMYIA (GONOMYIA) HORRIBILIS sp. nov. Plate 1, fig. 22; Plate 4, fig. 44.

Belongs to the *noveboracensis* group; antennæ black throughout; thoracic pleura striped longitudinally with brown and yellow; wings brownish yellow, stigma vaguely darker but undelimited; Rs shorter than the long, nearly straight R_{2+3+4}; male hypopygium with three dististyles; phallosome of unusual size and complexity, there being about six spinous points and branches on either side, some of these arms further complicated by delicate, pale setulæ.

Male.—Length, about 5 millimeters; wing, 5.5.

Female.—Length, about 6 millimeters; wing, 6.

Rostrum obscure yellow or brownish yellow; palpi black. Antennæ black throughout; flagellar segments elongate, with long, conspicuous verticils, especially on intermediate segments. Head dark gray, occipital region obscure yellow medially.

Pronotum yellow above, more obscure on sides. Mesonotum almost uniform brownish gray, scutellum extensively obscure yellow. Pleura and pleurotergite obscure yellow, with a conspicuous, brown, longitudinal stripe extending from cervical region across dorsal pleurites, ending on pteropleurite; ventral sternopleurite somewhat less evidently darkened. Halteres pale. Legs with coxæ and trochanters yellow; remainder of legs brownish yellow, tarsal segments passing into black. Wings (Plate 1, fig. 22) with a brownish-yellow suffusion, prearcular and costal fields clearer yellow; stigmal region vaguely darker, undelimited; veins brown, prearcular veins, Sc and Cu_2, clearer yellow. Venation: Sc_1 ending opposite origin of Rs, Sc_2 at its tip; Rs shorter than the long, nearly straight R_{2+3+4}; m-cu about one-half its length beyond fork of M.

Abdominal tergites dark brown, pruinose, the narrow caudal borders of the segments and the pleural membrane yellow; sternites more uniformly yellow; genital segment obscure yellow. Male hypopygium (Plate 4, fig. 44) of unusual complexity, especially in the details of the phallosome, *p*. Basistyle, *b*, on mesal face before apex with a tubercle bearing three strong, powerful setæ. Three dististyles, the outer, *od*, longest, slender, distal portion a little expanded; intermediate style, *md*, shorter, very widely expanded at distal end, truncate or gently concave margin with about a dozen pale setæ in a linear row; inner style, *id*, shortest, appearing as a boomerang-shaped structure terminating in several long setæ, including usual fasciculate pair; outer margin of style at midlength expanded into a pale flange bearing two separated, pale, spinous setæ; at base of this flange a further triangular pale blade or lobe. Phallosome, *p*, of unusual complexity, as roughly shown by the figure, where only the structures of a single side are shown; there are no less than six such arms and branches, of which three bear delicate setæ; of the glabrous rods one is very small and inconspicuous; at the base of the phallosome are two short, blackened lobes that are densely set with short setulæ. Besides the parts shown, the phallosomic mass shows still further complexities of hair brushes that cannot be describe at this time.

Habitat.—Japan, Honshiu.

Holotype, male, Kamikochi, altitude 5,000 feet, June 13, 1939 (*Suenson*). Allotopotype, female, pinned with type. Paratopotypes, 3 females, June 13 to July 24, 1939.

The only described species of the *noveboracensis* group are the western Palæartic *Gonomyia* (*Gonomyia*) *edwardsi* Lackschewitz and G. (*G.*) *ithyphallus* Lackschewitz, the eastern Nearctic *G.* (*G.*) *noveboracensis* Alexander, and the western Nearctic *G.* (*G.*) *aciculifera* Alexander. The discovery of a species in the eastern Palæarctic region is thus of very great interest. All five species have the dististyles of the male hypopygium of the approximate nature above described and all have the tremendously complicated phallosome, the species differing among themselves in various details of structure of both the styli and the phallosome.

ORMOSIA (ORMOSIA) DEPRAVA sp. nov. Plate 1, fig. 23.

Allied to *prava;* general coloration of body polished black; antennæ black; halteres pale yellow; femora yellow, tips broadly blackened; wings yellow, heavily washed and clouded with brown, especially along cord and veins Cu and 2d A; Sc_2 about opposite one-third length of Rs; cell 1st M_2 small, only about one-half as long as vein M_4 beyond it; caudal borders of abdominal tergites and sternites narrowly obscure yellow.

Female.—Length, about 8 millimeters; wing, 7.

Rostrum black; palpi dull black. Antennæ black throughout; flagellar segments oval, ends truncated; outer segments more elongate; longest verticils exceeding segments. Head black.

Thorax uniformly black, surface nitidous, especially præscutum. Halteres pale yellow, stem more whitened. Legs with coxæ black; trochanters brownish yellow; femora yellow, tips broadly blackened, unequally so on various legs, on fore pair involving about distal half, on middle and hind legs about distal third; tibiæ and basitarsi brownish black, tips narrowly blackened, posterior tibiæ paler than remaining tibiæ; remainder of tarsi black. Wings (Plate 1, fig. 23) with ground color yellow, conspicuously washed and clouded with brown; stigma long-oval, dark brown; broad washes the entire length of vein Cu in both cells M and Cu; a similar seam along vein 2d A involving cells on either side; a very extensive cloud along cord, slightly involving cells basad of cord but especially suffusing bases of outer radial and medial cells, appearing as seams to certain of the veins to the wing tip or nearly so;

prearcular and costal fields uniformly clear yellow; veins yellow in the flavous areas, brown in the infuscated portions. Macrotrichia of cells abundant, involving all cells of wing. Venation: Sc long, Sc_1 ending just before R_2, Sc_2 far from its tip, about opposite one-third length of Rs; Rs long and straight; R_2 just beyond fork of R_{2+3+4}; veins R_3 and R_4 turned slightly upward or cephalad; cell 1st M_2 small, rectangular, only about one-half length of vein M_4 beyond it; m-cu about one-fourth to one-fifth its length beyond fork of M; vein 2d A only gently sinuous, cell wide.

Abdomen polished black, caudal margins of both tergites and sternites narrowly obscure brownish yellow; genital segment black; valves of ovipositor yellow.

Habitat.—Japan, Honshiu.

Holotype, female, Kamikochi, altitude 5,000 feet, June 13, 1939 (*Suenson*).

Most closely allied to *Ormosia* (*Ormosia*) *prava* Alexander, of northern Korea. In the female sex the two species differ especially in the coloration of the wings and legs, and in the venation, as the more elongate R_{2+3+4} of the present fly.

ORMOSIA (ORMOSIA) NIPPOALPINA sp. nov. Plate 1, fig. 24; Plate 4, fig. 45.

Belongs to the *nigripila* group; general coloration polished black; wings with a strong brown tinge; R_{2+3+4} relatively short, about one and one-half as long as basal section of R_5; cell 1st M_2 open by atrophy of m; petiole of cell M_3 short, subequal to or shorter than m-cu; anal veins divergent; male hypopygium with ædeagus subtended by broadly flattened and depressed pale phallosomic plates.

Male.—Length, about 4.5 millimeters; wing, 5.3.

Female.—Length, about 5 millimeters; wing, 5.7.

Rostrum and palpi black. Antennæ brownish black throughout, of moderate length, if bent backward extending nearly to wing root; flagellar segments oval to long-oval, longest verticils very conspicuous, nearly twice as long as segment; a dense white pubescence additional to verticils. Head black.

Thorax uniformly polished black, only pronotal scutellum and very restricted anterior lateral pretergites clear light yellow, the latter color even more obscured in the female. Halteres pale, knobs clear light yellow. Legs with coxæ black; trochanters brown; remainder of legs black, femoral bases restrictedly yellow, more conspicuous on forelegs. Wings (Plate 1, fig. 24)

with a strong brown tinge, prearcular portion clearer yellow; veins pale brown, more brightened in the flavous portions. Macrotrichia of cells relatively abundant, lacking in the cells at and near the region of arculus. Venation: R_{2+3+4} relatively short, about one and one-half as long as basal section of R_5; R_2 a little exceeding R_{2+3}; cell M_2 open by atrophy of m; petiole of cell M_3 short, subequal to or shorter than m-cu; anal veins divergent.

Abdomen, including hypopygium, polished black. Ovipositor with cerci horn-yellow, blackened at bases. Male hypopygium (Plate 4, fig. 45) with structure of dististyles, *id, od,* much as in other members of *nigripila* group, apical point of outer style, *od,* relatively short. Ædeagus subtended by broadly flattened and depressed pale phallosomic plates, *p.*

Habitat.—Japan, Honshiu.

Holotype, male, Kamikochi, altitude 5,000 feet, June 23, 1939 (*Suenson*). Allotopotype, female, with the type.

The present fly is entirely distinct from *Ormosia* (*Ormosia*) *diversipes* Alexander, the only other Japanese member of the group, in its open cell 1st M_2, polished-black coloration of the thorax, and in the structure of the male hypopygium. In the present fly the legs are similarly blackened in both sexes, not being differently colored in the males and females, as in *diversipes* and in *O.* (*O.*) *nigripennis* Alexander, of western China.

ERRATUM

Due to a regrettable oversight certain of the illustrations for Parts XLI [Phil. Jour. Sci. 71 (1940) 75] and XLII [Phil. Jour. Sci. 71 (1940) 203] of this series have been transposed. Plate 1 at the end of Part XLI belongs to Part XLII, and Plate 1 at the end of Part XLII belongs to Part XLI. The author has kindly corrected the error in all the reprints distributed by him.—EDITOR.

ILLUSTRATIONS

[Legend: *a*, ædeagus; *b*, basistyle; *g*, gonapophysis; *i*, interbase; *id*, inner dististyle; *od*, outer dististyle; *p*, phallosome; *s*, sternite; *t*, tergite.]

Plate 1

Fig. 1. *Tanyptera chrysophæa* sp. nov.; venation.
2. *Ctenacroscelis persessilis* sp. nov.; venation.
3. *Tipula* (*Yamatotipula*) *kamikochiensis* sp. nov.; venation.
4. *Tipula* (*Acutipula*) *receptor* sp. nov.; venation.
5. *Tipula* (*Schummelia*) *crastina* sp. nov.; venation.
6. *Tipula* (*Oreomyza*) *lacunosa* sp. nov.; venation.
7. *Tipula* (*Oreomyza*) *subdepressa* sp. nov.; venation.
8. *Nephrotoma alticrista* sp. nov.; venation.
9. *Nephrotoma circumcincta* sp. nov.; venation.
10. *Cylindrotoma angustipennis* sp. nov.; venation.
11. *Limonia* (*Dicranomyia*) *poli* sp. nov.; venation.
12. *Limonia* (*Dicranomyia*) *retrograda* sp. nov.; venation.
13. *Orimarga* (*Orimarga*) *fokiensis* sp. nov.; venation.
14. *Dicranoptycha suensoniana* sp. nov.; venation.
15. *Dicranoptycha malabarica* sp. nov.; venation.
16. *Dicranota* (*Eudicranota*) *radialis* sp. nov.; venation.
17. *Limnophila* (*Elæophila*) *latinigra* sp. nov.; venation.
18. *Limnophila transitoria* sp. nov.; venation.
19. *Hexatoma* (*Eriocera*) *coomani* sp. nov.; venation.
20. *Hexatoma* (*Eriocera*) *tonkinensis* sp. nov.; venation.
21. *Gonomyia* (*Lipophleps*) *bimucronata* sp. nov.; venation.
22. *Gonomyia* (*Gonomyia*) *horribilis* sp. nov.; venation.
23. *Ormosia* (*Ormosia*) *deprava* sp. nov.; venation.
24. *Ormosia* (*Ormosia*) *nippoalpina* sp. nov.; venation.

Plate 2

Fig. 25. *Tanyptera chrysophæa* sp. nov.; female antenna.
26. *Tipula* (*Yamatotipula*) *kamikochiensis* sp. nov.; male hypopygium.
Figs. 27 and 28. *Tipula* (*Acutipula*) *receptor* sp. nov.; male hypopygium.
Fig. 29. *Tipula* (*Schummelia*) *crastina* sp. nov.; male hypopygium.

Plate 3

Fig. 30. *Tipula* (*Oreomyza*) *lacunosa* sp. nov.; male hypopygium.
Figs. 31 to 33. *Tipula* (*Oreomyza*) *subdepressa* sp. nov.; male hypopygium.
Fig. 34. *Nephrotoma alticrista* sp. nov.; male hypopygium.
35. *Limonia* (*Dicranomyia*) *poli* sp. nov.; male hypopygium.
36. *Limonia* (*Dicranomyia*) *retrograda* sp. nov.; male hypopygium.

PLATE 4

FIG. 37. *Orimarga* (*Orimarga*) *fokiensis* sp. nov.; male hypopygium.
38. *Dicranoptycha suensoniana* sp. nov.; male hypopygium.
39. *Dicranoptycha malabarica* sp. nov.; male hypopygium.
40. *Limnophila* (*Elæophila*) *latinigra* sp. nov.; male hypopygium.
41. *Limnophila* (*Elæophila*) *similissima* sp. nov.; male hypopygium.
42. *Limnophila transitoria* sp. nov.; male hypopygium.
43. *Gonomyia* (*Lipophleps*) *bimucronata* sp. nov.; male hypopygium.
44. *Gonomyia* (*Gonomyia*) *horribilis* sp. nov.; male hypopygium.
45. *Ormosia* (*Ormosia*) *nippoalpina* sp. nov.; male hypopygium.

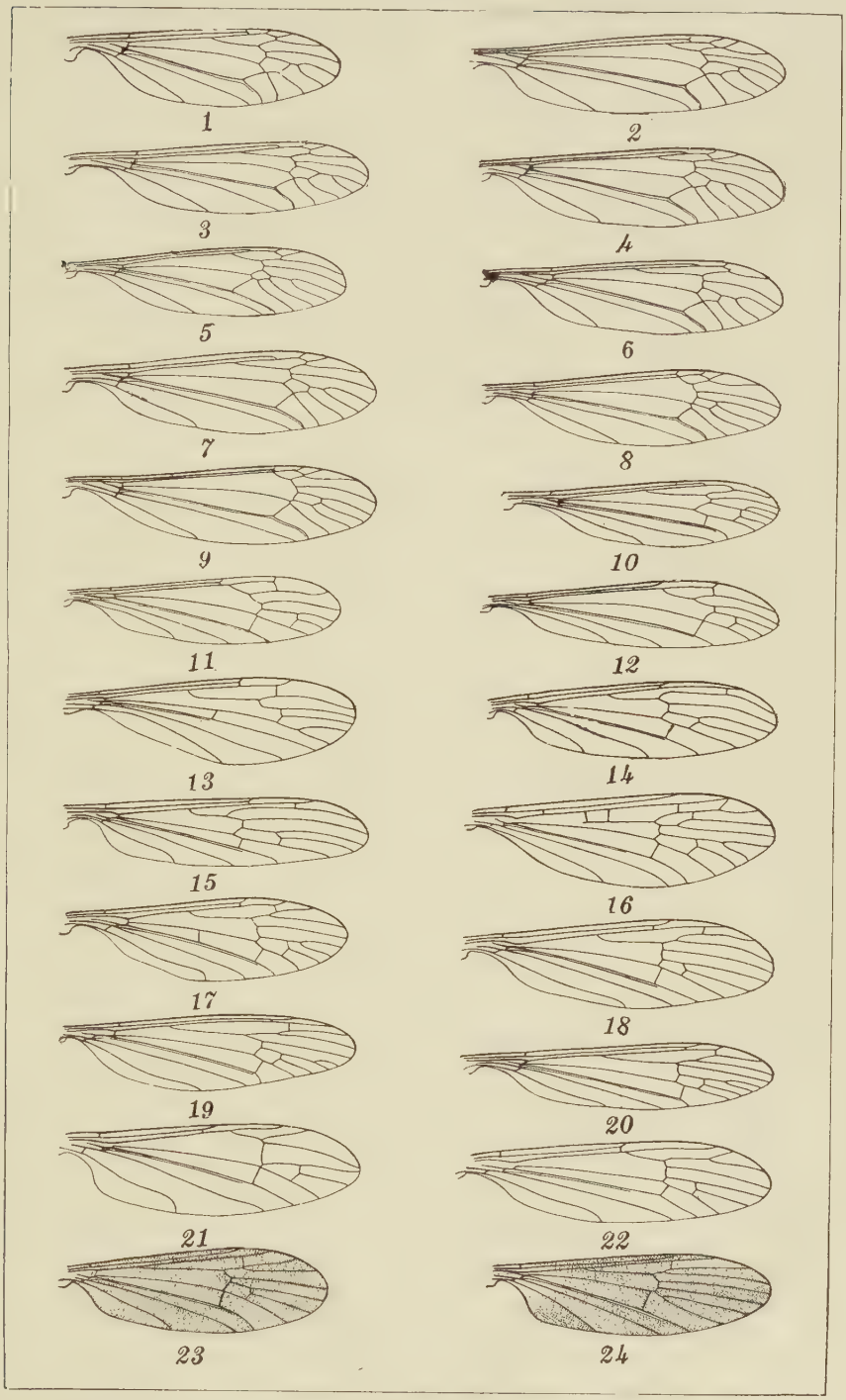

PLATE 1.

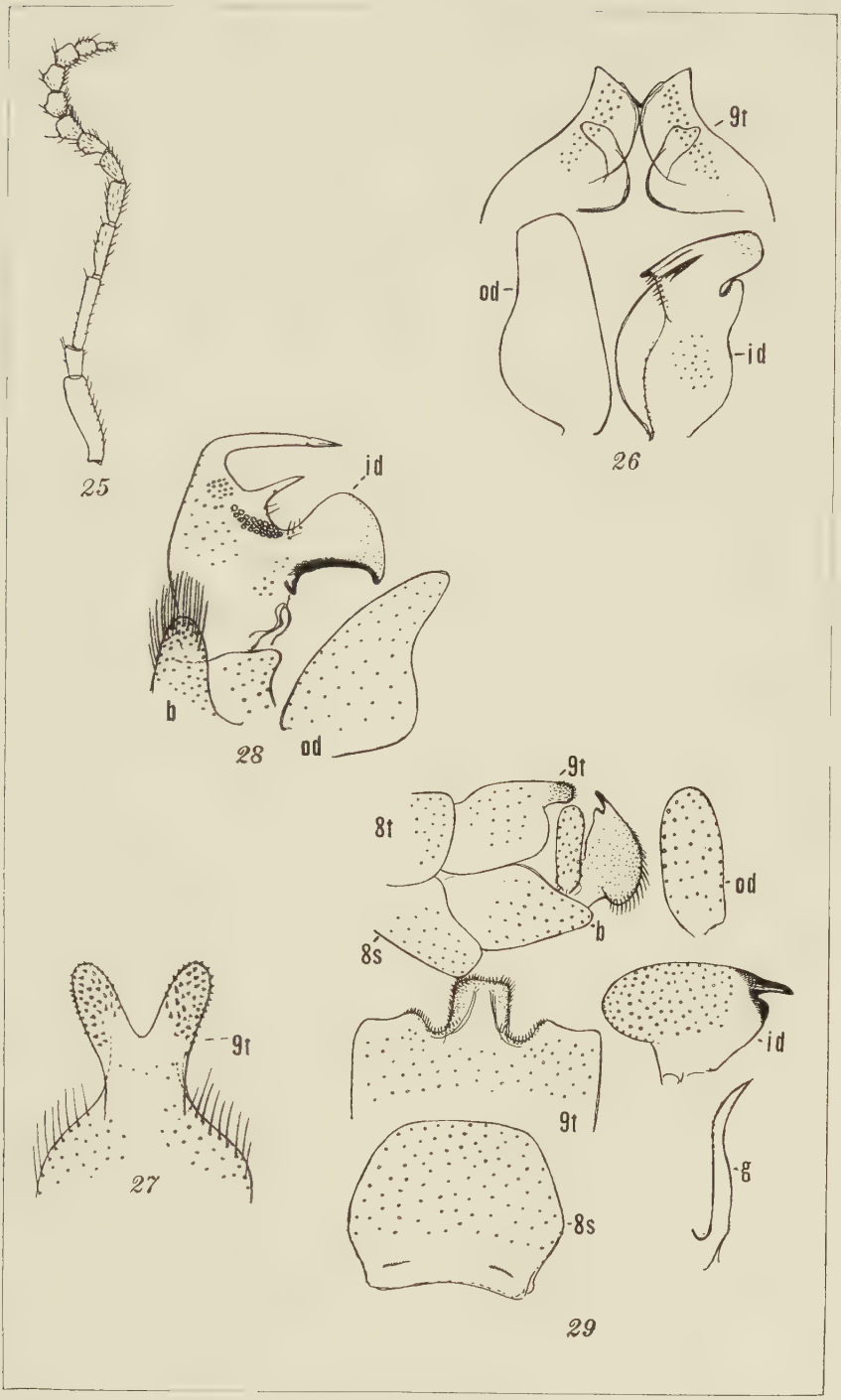

PLATE 2.

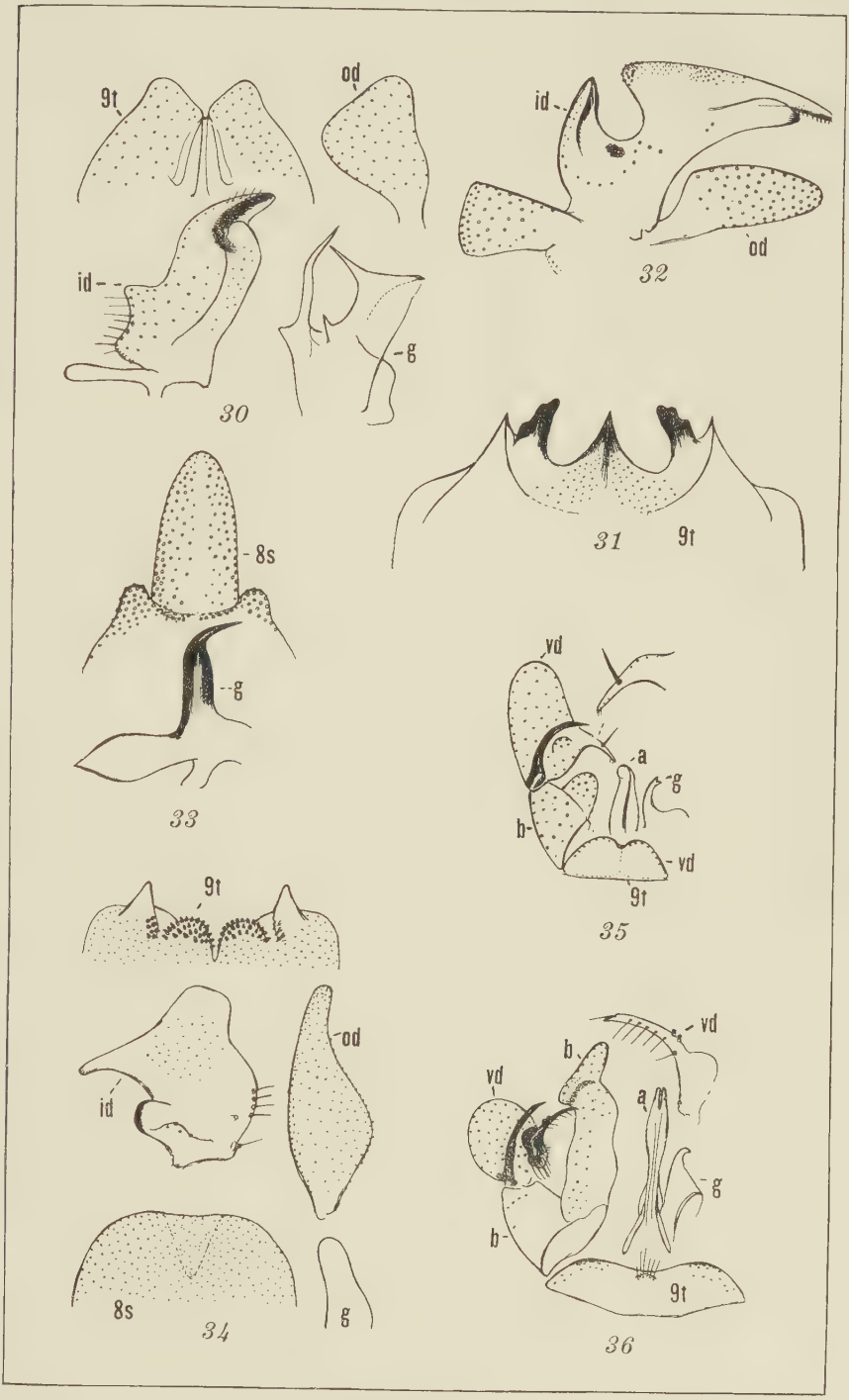
9t
od
id
g
30
id
od
32
31
9t
8s
g
33
vd
a
g
b
vd
9t
35
9t
od
id
8s
g
34
vd
b
vd
a
g
b
9t
36

PLATE 3.

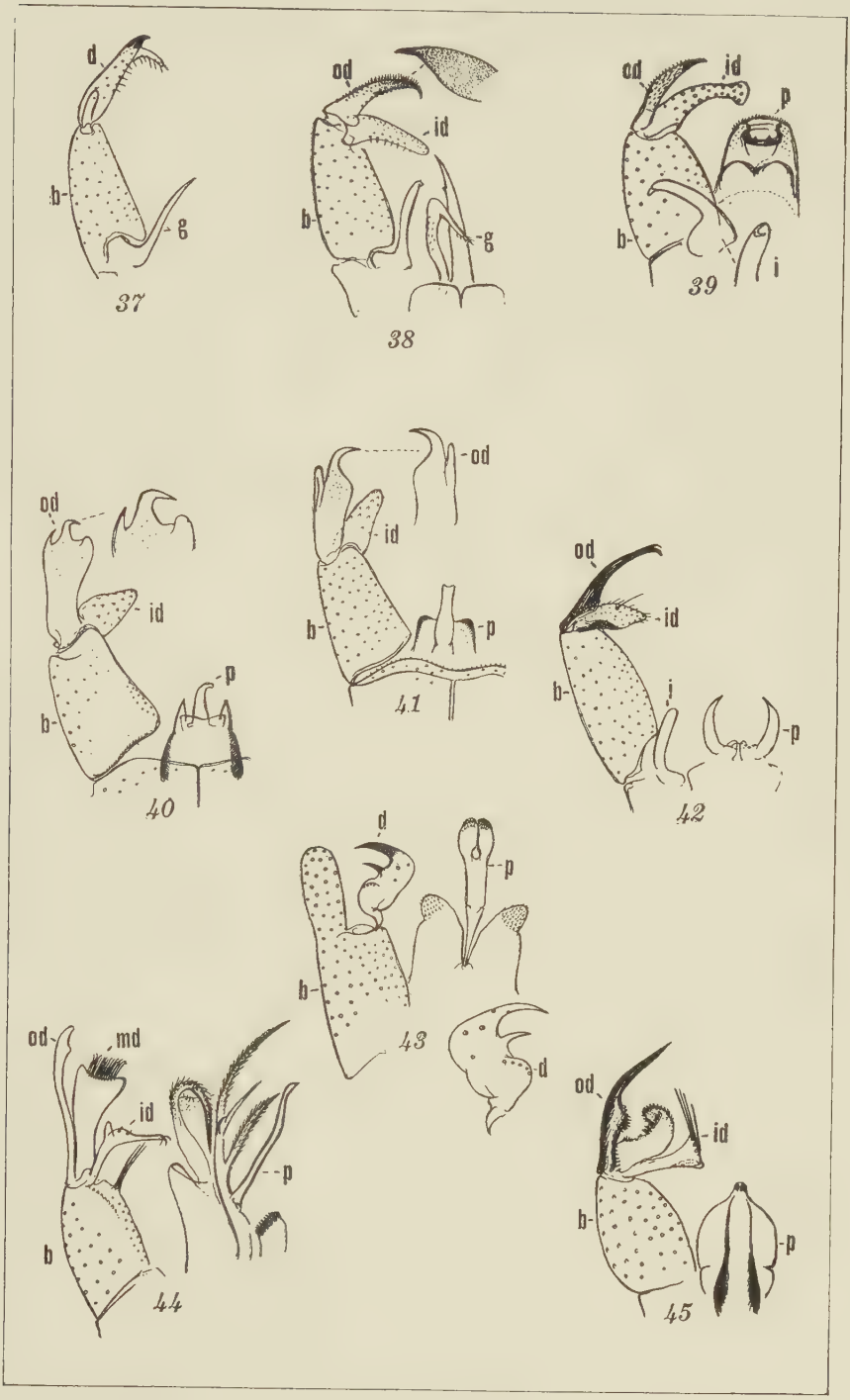
d
b
g
37
od
id
b
g
38
od
id
p
b
i
39
od
id
b
p
40
od
id
b
p
41
od
id
b
p
42
d
p
b
43
d
od
md
id
p
b
44
od
id
b
p
45

PLATE 4.

OCTOCORALLIA FROM PHILIPPINE WATERS

By G. Stiasny

Curator of Cœlenterates, Rijksmuseum van Natuurlijke Historie Leiden, Netherlands

TWO PLATES

This paper is based on the study of a collection of Octocorallia from the Philippines, sent me by Dr. Hilario A. Roxas, formerly of the Division of Fisheries, Department of Agriculture and Commerce, and consisting of 12 specimens, classified in the following manner:

Alcyonarians:[1]

MELITODIDÆ

Mopsella aurantia (Esper) 2
Acabaria formosa Nutting 2

Gorgonarians:

PLEXAURIDÆ

Psammogorgia nodosa Kükenthal 1
Plexaura roxasi sp. nov. 1

MURICEIDÆ

Perisceles ceylonensis (Thoms. & Hend.) 3
Perisceles fruticosa Wright & Studer 2

ACANTHOGORGIIDÆ

Acanthogorgia dofleini Kükenthal and Gorzawaky 1

There is one new species, *Plexaura roxasi.* All the other forms, with the exception of *Perisceles ceylonensis,* are new records for the fauna of the Philippines.

Kükenthal (2, p. 809) says that the gorgonarian fauna of the Philippines is extremely poor. He enumerates 18 different species belonging to 15 genera, all of which are represented also, and by a much larger number of species, in the Malayan Archipelago. He, therefore, regards the gorgonarian fauna of Philippine waters as a strongly impoverished Malayan fauna, of which it forms only a part, because it does not contain a single foreign

[1] *See* my new system of Octocorallia (1939).

element. He points out that the families of Suberogorgiidæ, Coralliidæ, and Primnoidæ, so well represented in the Malayan Archipelago, are not represented at all in Philippine waters, and concludes that the Philippine fauna of gorgonarians cannot be regarded as a transitional one to that of Japan.

In my memoir on the gorgonarians from French Indochina (6, p. 357) I said that I did not agree with Kükenthal's opinion that the Philippine fauna of gorgonarians should be such a poor one, that the alleged poverty of this region in Gorgonaria (Holaxonia), while it is so rich in madreporarians and certain alcyonarians (Xeniidæ, Cornulariidæ, Alcyonidæ, Nephthyidæ) is certainly attributable only to inadequate collection, and that on the whole the Octocorallia fauna of the Philippines might not be poorer than the faunæ of the surrounding regions, and might be more or less of the same character.

Already in 1939 I had the opportunity of studying one collection of gorgonarians from the Philippines, belonging to the National Museum in Paris.(8) I discovered that my original opinion was entirely justified. There were found 6 different species (one new) not reported before from this region, representing elements from the Indian Ocean, the Malayan Archipelago, Australia, and Japan.

The present small collection contains, besides a new species, 5 species not hitherto recorded from Philippine waters, but known from India, the Malayan Archipelago, Australia, and Japan, thus presenting the same character as the collection from the Paris Museum. As we see that in each new collection studied there are found new species or new components, one can hardly believe that the gorgonarian fauna of the Philippines is already sufficiently explored. We can, on the contrary, expect with certainty that further exploration will afford further species not yet recorded from these waters, especially species of the family Suberogorgiidæ, represented so abundantly in the neighboring regions. Moreover, while the great depths near the Philippines are inadequately explored with regard to gorgonarians, the known species being almost all littoral forms, in the Malayan Archipelago the great depths have been rather sufficiently explored. Contrary to Kükenthal's opinion, the character of the Philippine gorgonarian fauna cannot be regarded as identical with that of the Malayan Archipelago; but as far as we know at present, it bears the traces of a transitional

fauna between that of the Malayan Archipelago and that of those of the surrounding regions, including Japan.

A complete up-to-date list of all gorgonarians (in the sense of Kükenthal) is much richer than that given by this author in 1919, (2, p. 809) and may be summarized as follows:

Semperina rubra
Solenocaulon tubulosum
? Mopsella sinuata
Mopsella aurantia
Acabaria philippinensis
Acabaria formosa
Plexaura roxasi
Psammogorgia nodosa
Psammogorgia perroteti
Echinogorgia gracillima
Echinogorgia sasappo
Echinomuricea philippinensis
Muriceides fragilis
Perisceles fruticosa
Perisceles ceylonensis
Brandella inermis
Acanthogorgia longiflora
Acanthogorgia dofleini
Pseudopterogorgia luzonica
Junceella squamata
Junceella fragilis
Ellisella andamanensis
? Gorgonella cumingi
Gorgonella spinescens
Chrysogorgia axillaris
Chrysogorgia geniculata
Ceratoisis philippinensis
Isis reticulata

There are thus known from Philippine waters at present 29 different species in place of 18 in the list of Kükenthal. All specimens are in a good state of preservation (alcohol).

Order ALCYONARIA (SCLERAXONIA) Stiasny

Suborder MELITODACEA Stiasny

Family MELITODIDÆ Wright and Studer

Genus MOPSELLA Gray

MOPSELLA AURANTIA (Esper).

For synonyms, *see* Kükenthal. (3, p. 67)

Two specimens, height 130 and 120 mm, without base. More or less densely ramified, with anthocodia expanded.

Distribution.—Malayan Archipelago, northwestern Australia. Rather common form. New record from the Philippines.

Genus ACABARIA Gray

ACABARIA FORMOSA Nutting.

For synonyms, *see* Hickson (1, p. 160) and Kükenthal. (3, p. 77)

Two specimens, 30 and 50 mm long, bifurcated. Cœnenchyma whitish, anthocodia yellow, axis intensely red.

Hitherto known only from Banda Sea.

Order GORGONARIA (HOLAXONIA) Stiasny

Family PLEXAURIDÆ

Genus PSAMMOGORGIA Verrill

PSAMMOGORGIA NODOSA Kükenthal.

For synonyms, *see* Kükenthal (3, p. 108) and Stiasny. (5, pp. 39, 42; pl. 1, fig. 4, text fig. L; 6, p. 360)

One specimen, height 240 mm, largest diameter 65, without base. Grayish brownish. This species is reported from New Britain, Banda, Amboina, Madagascar, and Lourenco Marques. New for the fauna of the Philippines.

Genus PLEXAURA Verrill

PLEXAURA ROXASI sp. nov. Plate 1; Plate 2, figs. 1 to 9.

One specimen and numerous small pieces. Height 180 mm, largest diameter 105, without base.

Ramified in one plane, pinnate. Principal branch visible throughout its length, a little thicker than lateral branches, feebly compressed. Lateral branches cylindrical, not thickened at their free ends, not ramified, originating in regular distances in a right angle opposite or alternating, about 100 mm long. Surface of principal branch smooth, with fine longitudinal furrows, that of lateral branches a little rough. Calices on principal branch only on lateral sides, in longer or shorter series, on lateral branches distributed on whole surface in form of low, round verrucæ with feebly developed operculum. Axis strongly calcified, loculated. A circle of thin longitudinal canals around it. Grayish, brownish, yellowish.

Spicules (Plate 2, figs. 1 to 9): Warted knobs (Warzenkeulen) (Plate 2, figs. 1 to 3), transitional forms to foliated knobs (Blattkeulen) (Plate 2, fig. 3), with a few large warts on the swollen part and with a long, poorly-warted stele, 0.096 mm long. Spindles strongly bent, with a few rough warts, on one side much higher than on the other (Plate 2, figs. 4 and 5), 0.09 to 0.12 mm long; sticks bent (Plate 2, fig. 6), or straight (Plate 2, fig. 7), with a few plain warts, other spindles very long, thin, strongly bent, with pointed ends (Plate 2, fig. 8), 0.168 mm long. In anthocodia very small spindles, plane, 0.03 to 0.05 mm long. All spicules transparent. The small pieces are mostly lateral branches, cylindrical, with more or less rough surface, 100 mm long.

This species is related to *Plexaura flava* Nutting from the Malayan Archipelago.[1] Differences: ramified in one plane, principal branch compressed. Lateral branches cylindrical, long. Many strongly bent spindles with warts very much higher on one side than on the other. No knots with spines (Atachelkeulen).

Diagnosis.—Ramified in one plane, pinnate. Principal branch compressed with smooth surface. Lateral branches cylindrical, not thickened at their free ends, with rougher surface, originating in regular distances. Opposite or alternating nearly in a right angle, about 100 mm long. Calices in form of low verrucæ with a feebly developed operculum, on principal branch in lateral series, on lateral branches distributed over the entire surface. Axis strongly calcified, loculated, surrounded by a circle of thin longitudinal canals. Spicules: warted knobs (Warzenkeulen) and transitional forms to foliated knobs (Blattkeulen) with a few large warts on the swollen part with a long thin stele poorly warted, about 0.096 mm long; spindles strongly bent, with a few plain warts, warts on one side much higher than on other, 0.09 to 0.12 mm long; sticks straight or bent, with a few plain warts, others strongly bent with pointed ends, about 0.168 mm long. In the operculum very small smooth spindles, 0.03 to 0.05 mm long. All transparent. Grayish, brownish, yellowish.

Locality.—Puerto Galera Bay, Mindoro, Philippines.

Family MURICEIDÆ Verrill

Genus PERISCELES Wright and Studer

PERISCELES CEYLONENSIS (Thoms. and Hend.). Plate 2, figs. 10 to 17.

For synonyms, *see* Kükenthal, (3, p. 193).

Three small specimens 35 to 40 mm high.

This species is recorded from Ceylon, Providence Island, Solomon Islands, mostly from greater depths. I have also indicated this species from the Philippines in my paper on the gorgonarians from the National Museum, Paris. The spicules have not been figured hitherto.

Spicules (Plate 2, figs. 10 to 17): In the cœnenchyma the predominant form is a very large conspicuous type, composed of a foliaceous polyradiate base (Vielstrahler), from which arises

[1] Compare Nutting's description (4, p. 8, pl. 2, fig. 1; pl. 4, fig. 6, a–d) and Stiasny's (5 pp. 55–57, pl. 4, fig. 21, text fig. P).

a spatulated or pointed projection, more or less splintered at the free end (Plate 2, figs. 10 to 12), with large warts in the center of the plate and small warts on the projections, 0.102 to 0.1286 mm long. In the calices S-shaped spindles (Plate 2, fig. 14) or bifurcated spindles (Plate 2, fig. 13), with a few rough warts, 0.12 to 0.16 mm long, others strongly bent with large projections on the concave inner side and small warts in the middle part (Plate 2, figs. 15 and 16), 0.168 mm long. In the tentacles, small sticks forked on one end or with thorns poorly warted, 0.06 mm long. All transparent.

PERISCELES FRUTICOSA Wright and Studer.

For synonyms, *see* Kükenthal. (3, p. 196)

Two specimens, with small pieces, 110 mm high, 85 mm broad, without base; 42 mm high, 24 mm broad, base 3 mm broad. This species is known from different localities in the Malayan Archipelago. Recorded for the first time from the Philippines.

Family ACANTHOGORGIIDÆ Kükenthal and Gorzawaky

Genus ACANTHOGORGIA Gray

ACANTHOGORGIA DOFLEINI Kükenthal and Gorzawaky.

One specimen, 90 mm high, 70 mm broad, without base.

This species is recorded hitherto exclusively from Japan (Sigami Bay).

REFERENCES

1. Hickson, S. J. The family Melitodidae. Trans. Zool. Soc. London (1937).
2. Kükenthal, W. Gorgonaria. Ergeb. Deutsche Tiefsee Exp. "Valdivia" (1, 2) 13 (1919).
3. Kükenthal, W. Gorgonaria. In "Das Tierreich" 47 (1924).
4. Nutting, C. C. The Gorgonacea of the Siboga Expedition. IV. Plexauridae. Siboga-Expeditie 12 (1910).
5. Stiasny, G. Die Gorgonacea der Siboga Expedition. Supplement II. Revision der Plexauridae. Siboga-Exp. b 7 13 (1937).
6. Stiasny, G. Die von Dr. C. Dawydoff in französisch Indochina gesammelten Gorgonarien. Mem. Mus. National Paris Nouv. VI (1938).
7. Stiasny, G. System der Octocorallia. Zoolog. Meded. Leiden 21 (1939).
8. Stiasny, G. Gorgonides des Philippines. Arch. Mus. Nat. Paris (1940).
9. Stiasny, G. Alcyonaria und Gorgonarie der "Snellius" Expedition. Temminckia (1940).
10. Stiasny, G. Gorgonides de Madagascar. Îles Maurice et Reunion. Arch. Mus. Nat. Paris (1940).
11. Stiasny, G. Gorgonaria von Lourenco Marques. Arquivos Museu Bocage. Lissabon (1940).

ILLUSTRATIONS

PLATE 1. PLEXAURA ROXASI SP. NOV.

PLATE 2. PLEXAURA ROXASI SP. NOV.

FIGS. 1 to 9. The whole colony, natural size; 10 to 17, *Perisceles ceylonensis*, part of colony; principal branch with smooth surface, lateral branches cylindrical with low verrucæ. On left, lateral branch not thickened at its free end; × 6.

1

2

PLATE 1.

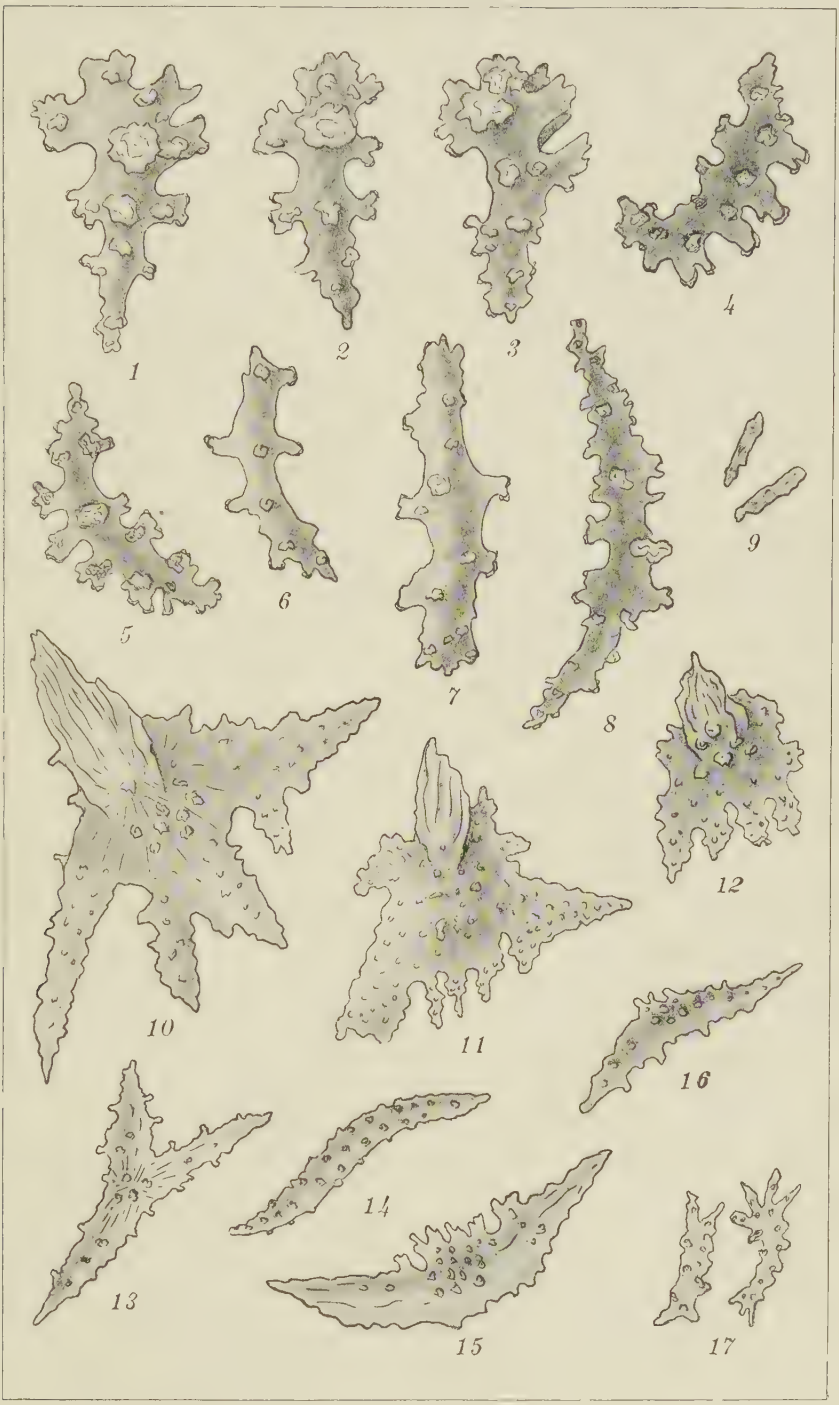

PLATE 2.

BOOKS

Books reviewed here have been selected from books received by the Philippine Journal of Science from time to time and acknowledged in this section.

REVIEWS

Diagnosis and Treatment of Diseases in the Tropics. By H. C. Trowell. London, Bailiére, Tindall and Cox, 1939. 205 pp., illus. Price, 2s /6d.

This book is primarily intended for Africans. It is also designed to give general information about medical and surgical diseases frequently encountered in the Tropics by nurses or orderlies, who have to take the place of doctors under certain conditions. It is easy to understand and recommends itself to those who have little medical education and knowledge of English.—G. F. A.

Chemistry and Medicine. Papers Presented at the Fiftieth Anniversary of the Founding of the Medical School of the University of Minnesota. Edited by Maurice B. Visscher. Minneapolis, The University of Minnesota press, 1940. 296 pp., illus. Price $4.50.

As may be gathered from the foreword, this book is a collection of papers read at the 50th Anniversary of the establishment of the University of Minnesota Medical School. The articles are of interest to physical chemists, nutritionists, immunologists, and neurophysiologists. Each article is an exposé of some subject with which the author is thoroughly conversant, having himself undertaken researches along its line. When an article deals with a controversial topic, the author analyzes existing evidence in favor of or against a given theory in such lucid manner that the reader gets a clear view of the controversy without the necessity of going over numerous papers published on the subject. A case in point is Cannon's article on Chemical Mediation of Nerve Impulses. Between chemagonists and electragonists, there are points of agreement; these are set aside. In points of difference, the facts are presented and discussed from the viewpoint of both chemical and electrical theories. Any one who desires to know the present status of transmission

of nerve impulse across a synapse will find the article interesting reading.—W. P.

The Mixing of Colors and Paints. By F. N. Vanderwalker. Chicago, Frederick J. Drake & Co., 1939. 292 pp., illus. Price, $2.

This book furnishes practical information on the use of colors, paints, and printing inks. Painters, decorators, printers, and others whose professions are intimately related to the proper mixing and blending of colors, will find in this book practical methods which will serve them as a guide to the solution of their daily problems. The principles regarding the most effective use of colors have been reduced to the most simple terms for the layman to comprehend and to put into practical use.

Valuable information on the recent progress and changes made in the composition of various paint materials in the various forms in which they are marketed, as well as standard formulas of ready mixed paints ground in oil, is given. A chapter on printing inks has been included. The author gives a brief history of the essential constituents of printing inks, such as pigments and dyes, oils and varnishes, waxes and ink driers, and the characteristics of ink any ink maker should know. It is, indeed, a very useful book for workers on colors and paints.

—R. H. A.

Vegetable Dyes. By Ethel M. Mairet. New York, Chemical Publishing Co., Inc., 1939. 68 pp. Price $2.

This book contains formulas and other information useful to both the weaver and the dyer. The author gives the characteristics of wool, silk, cotton, and linen, and the different ways of dyeing each with the use of vegetable dyes. It also gives the properties of mordants and other chemicals that are used in dyeing, and the kind of water to be used for the purpose.

This book will be of interest to home dyers, especially in the provinces, who still make use of natural dying materials.

—M. R. A.

Coloring, Finishing and Painting Wood. By Adnah Clifton Newell. Peoria, Illinois, The Manual arts press, 1940. 480 pp., front., illus. Price, $4.50.

The finishing of wood has long been considered an art, and this book not only attempts to encourage its practice as such but also tries to raise it to the level of a science. It discusses exhaustively the different phases of the subject, especially those pertaining to the preparation of wood surfaces for staining, the

different wood stains and their sources, the artificial and natural varnishes, the materials used, and the method of application. It also discusses enamel and lacquer and the method of their application, as well as paints, the sources of materials, and the composition of different coats.

The interesting part of the book is the discussion on the use of synthetic resins for varnish. This new article may eventually replace the natural resins, just as some dyes derived from coal tar have replaced the indigo plant. Another subject of interest is the bleaching of wood. This process is especially useful in attaining uniform surface color in the furniture industry where woods used have variable colors.

The last chapter, devoted to the finishing of metals, is rather out of place under the title of the book, but actually it comes in handy in most woodworking shops, where a certain amount of metal finishing is being done.

The book as a whole is a good reference for any one interested in wood finishing and for foresters.—C. M.

Modern Projects in Woodwork. By J. H. Douglass and R. H. Roberts. Wichita, Kansas, The McCormick-Mathers Publishing Company, 1939. 128 pp., illus. Price, $2.25.

This book is a compilation of woodworking projects intended to be used in vocational high schools in the United States. The projects are more or less graded, starting with the simpler and following up with the more complicated ones as the student becomes more proficient. Each project includes helpful suggestions to the students as well as bills of necessary materials.

Each project is illustrated with drawings with the dimensions of each part given, so that an ordinary carpenter can carry it out without even reading the suggestions. To a student these drawings afford good practice in reading drawings and visualizing projects. He is further aided by photographic illustrations provided in this book. In cutting artistic features, as those having curve lines, the indirect suggestion of making 1- or ½-inch squares on cardboard or on paper and drawing the curve lines on these squares is good.—C. M.

Home Safety. By Priscilla R. Marble. New York, American Book Co., 1940. 144 pp., illus. Price, $0.80.

This book is written for boys and girls, and especially for housewives, whose work is primarily related to the home. It gives a presentation of a home in former days and today, where

safety and comfort are concerned. The first two chapters picture the homes and the mood of living in colonial days. The difficulties of living comfortably and the frequency of accidents during those days are well illustrated. Chapters three to five give the improvements of our modern homes with regard to comfort and safety. Improvements of lighting, heating, and plumbing in the different parts of a home, are well explained. Chapters six and seven give the proper safety measures outside the house, as porch, steps, garage, farmhouse, and farm yard. They also give rules and regulations to insure comfort and prevent calamities. The remaining chapters enumerate the different government agencies which help make a community safe, and the work done by each agency. They also give instructions regarding the application of remedial measures for different disasters that are apt to occur in any home.—V. D. K.

Manual of Mushroom Culture. By G. Raymond Rettew, Otis E. Gahm and Floyd W. Divine. Second Edition. West Chester, Pennsylvania, Chester County mushroom laboratories, 1938. 144 pp., illus. Price, $1.

This publication is intensive as well as comprehensive in its treatment of the art and science of mushroom culture. It covers the following essential aspects: (1) the mushroom industry; (2) mushroom culture; (3) diseases and pests of mushrooms (including their control); (4) technical studies of the mushroom; and (5) mushroom spawn production.

This publication is not only practical but also scientific, the authors—a chemist, an entomologist, and a grower—having made use of their experience and experiments in writing this book.—J. M. M.

A Field Key to Our Common Birds. By Irene T. Rorimer. Cleveland, Ohio, The Cleveland Museum of Natural History, 1940. 160 pp., illus. Price, $1.50.

This book is convenient for field identification of the birds of northeastern United States. It has no direct value to students of Philippine birds, but the presentation of the subject is noteworthy. Although there are objections to the grouping of birds on the basis of habitat, the purpose of the book and the arrangement of the headings justify the style. The illustrations, both halftone and colored, tremendously enhance the value of the book.—C. G. M.

A Dictionary of Scientific Terms. Pronunciation, Derivation, and Definition of Terms in Biology, Botany, Zoology, Anatomy, Cytology, Embryology, Physiology. By I. F. Henderson and W. D. Henderson. Third Edition, Revised by J. H. Kenneth. New York, D. Van Nostrand Co., 1939. 383 pp. Price, $7.

Although it shares the failing common to existing scientific dictionaries of trying to cover too many branches of science and not being sufficiently exhaustive in any of them, "A Dictionary of Scientific Terms" is undoubtedly one of the best of this type of compilations that have appeared so far. The definitions given are brief but adequate, and the derivations, intelligently used, are capable of increasing the usefulness of the book considerably, since they lend themselves to combinations not listed.

The greatest fault of the book lies in the subtitle and its implications. The careful worker in any field of science will be at once struck by the impossibility of including an exhaustive vocabulary on biology, botany, zoology, anatomy, cytology, embryology, and physiology in a book of less than four hundred pages. The only query that prompted me to open this book was the word "interveinicular," spelled so in a manuscript then before me. There are already four or five technical dictionaries at my disposal, which indeed have the more or less common terminologies I am working with, but which invariably fail me in the case of out-of-the-way words that stump me; of course I knew better than to go to them, with "interveinicular," and looked for this word in the book under review. It was not there, nor were any of its variants.

As a compilation of terms used in the biological sciences, the present book ranks with the best of its kind; however, like a dozen books that have preceded it, it does not meet the pressing need of the time for highly specialized vocabularies, exhaustive in their limited fields. It is hoped that this need will in the near future be appreciated and met by compilers as competent as Henderson and Henderson.—S. R.

RECEIVED

American Society for Testing Materials. Conversion tables for kinematic and saybolt universal viscosities based on and amplified from A. S. T. M. standard method for conversion of kinematic viscosity to saybolt universal viscosity (D446–39). Philadelphia, American society for testing materials, 1939.

American Society for Testing Materials. Viscosity index tables based on and amplified from A. S. T. M. tentative method for calculating viscosity index (D567–40T). Philadelphia, American society for testing materials, 1940.

Artificial light and its application. Bloomfield, New Jersey, Westinghouse electric & manufacturing co., 1940. 296 pp., illus.

BEAUFORT, L. F. DE. The fishes of the Indo-Australian archipelago. VIII. Percomorphi (continued) cirrhitoidea, labriformes, pomacentriformes. Leiden, E. J. Brill, 1940. 508 pp., illus.

BRITON-JONES, H. R. The diseases of the coconut palm. Revised by Ernest Entwisle Cheesman. London, Bailliére, Tindall and Cox, 1940. 176 pp., front., plates. Price, 10s /6d.

DUNCAN, IDA RILEY. The complete book of progressive knitting. New York, Liveright publishing corporation, 1940. 387 pp., illus. Price, $2.50.

JORDAN, H., and others. Tropical hygiene and sanitation. London, Bailliére, Tindall and Cox, 1939. 388 pp., illus. Price, 5s/–.

PERRY, JOSEPHINA. Around the world making cookies. New York, M. Barrows & co., inc., 1940. 157 pp., Price, $1.50.

REASON, H. A. The road to modern science. London, G. Bell & sons, ltd., 1939. 310 pp., plates, illus. Price, 6s/6d.

REINER, MIRIAM. Manual of clinical chemistry. New York, Interscience publishers, inc., 1941. 296 pp., illus. Price, $3.

RORIMER, IRENE T. A field key to our common birds. Pocket natural history no. 8. Zoological series no. 3. Cleveland, Ohio, The Cleveland museum of natural history, 1940. 160 pp., illus., plates. Price, $1.50.

RUDY, ABRAHAM. Simplified diabetic manual. New York, M. Barrows & co., inc., 1940. 215 pp., illus. Price, $2.

SMITH, GEDDES. Plague on us. New York, The commonwealth fund, 1941. 365 pp., plates. Price, $3.

SNEDECOR, GEORGE W. Statistical methods applied to experiments in agriculture and biology. 3d ed. Ames, Iowa, The Iowa state college press, 1940. 422 pp., illus. Price, $3.75.

Society of biological chemists, India. Annual review of biological and allied research in India, v. IX, 1938. Bengalore, Society of biological chemists, n. d. 167 pp. Price, Rs 3/6 sh.

Temperature; its measurement and control in science and industry New York, Reinhold publishing corporation, 1941. 1362 pp., illus. Price, $11.

TRANSEAU, E. N., and others. Textbook of botany. New York—London, Harper & brothers publishers, 1940. 812 pp., front, illus. Price $4.

TROWELL, H. C. Diagnosis and treatment of diseases in the tropics. London, Bailliére, Tindall and Cox, 1939. 205 pp., illus., Price, 2s/6d.

VERRILL, A. HYATT. Perfumes and spices including an account of soaps and cosmetics. Boston, L. C. Page & co., 1940. 304 pp., front., illus. Price, $3.

THE PHILIPPINE BUREAU OF SCIENCE

RECENT MONOGRAPHIC PUBLICATIONS

SUMMARY OF PHILIPPINE MARINE AND FRESH-WATER MOLLUSKS. By Leopoldo A. Faustino. Order No. 485. Bureau of Science Monograph 25. Paper, 384 pages. Price, $2 United States currency, postpaid.

SECOND TEN-YEAR INDEX TO THE PHILIPPINE JOURNAL OF SCIENCE, Volume 11 (1916) to Volume 28 (1925). By Winifred I. Kelly. Order No. 486. Bureau of Science Monograph 26. Paper, 381 pages. Price, $2 United States currency, postpaid.

THIRD TEN-YEAR INDEX TO THE PHILIPPINE JOURNAL OF SCIENCE, Volume 29 (1926) to Volume 58 (1935). By Sophie Rodolfo and Amando D. Singson. Philippine Department of Agriculture and Commerce Technical Bulletin 11. Paper, 432 pages. Price, $2.25 United States currency, postpaid.

FILTERABLE VIRUS AND RICKETTSIA DISEASES. By Earl Baldwin McKinley. Order No. 487. Bureau of Science Monograph 27. 442 pages, 70 plates, and 7 text figures. Prices, paper, $2.50; bound in full red keratol, $4, United States currency, postpaid.

EXPERIMENTAL STUDIES OF DENGUE. By James Stevens Simmons, Joe H. St. John, and Francois H. K. Reynolds. Order No. 489. Bureau of Science Monograph 29. Paper, 489 pages, 3 plates, and 159 text figures. Price, $3.50 United States currency, postpaid.

PHILIPPINE LAND MAMMALS. By Edward H. Taylor. Order No. 490 Bureau of Science Monograph 30. Paper, 548 pages, 25 plates and 25 text figures. Price, $2.50 United States currency, postpaid.

THE PHILIPPINE JOURNAL OF SCIENCE

Manuscripts intended for publication in the Philippine Journal of Science should be sent to the Editor, Philippine Journal of Science, Bureau of Science, post-office box 774, Manila, Philippines.

Manuscripts on biology must be accompanied by abstracts for publication in the Biological Abstracts.

Fifty separates of each paper published in the Journal are furnished to the author without charge. Additional copies may be had at the author's expense if ordered when the manuscript is submitted for publication.

The Journal is issued twelve times a year. The subscription price is 5 dollars United States currency per year. Single numbers, 50 cents each.

Subscriptions may be sent to the Division of Publications, Department of Agriculture and Commerce, post-office box 613, Manila, Philippines, or to any of the agents listed below.

Publications sent in exchange for the Philippine Journal of Science should be addressed: Scientific Library, Bureau of Science, post-office box 774, Manila, Philippines.

AGENTS

The Macmillan Company, 60 Fifth Avenue, New York, N. Y.
Martinus Nijhoff, Lange Voorhout 9, The Hague, Holland.
G. E. Stechert & Co., 31–33 East 10th Street, New York, N. Y.
The Maruzen Co., Ltd., 6 Nihonbasi, Tori-Nichome, Tokyo, Japan.

CONTENTS

	Page
ALEJO, LEON G., LUZ BAENS, and V. G. LAVA. The influence of hydrogen-ion concentration on the fixation of some Philippine vegetable tanning extracts by hide powder	1
MERRILL, E. D., and L. M. PERRY. A summary of Kentrochrosia Lauterbach and Schumann	19
COPELAND, EDWIN B. Miscellaneous ferns of New Guinea	23
ALEXANDER, CHARLES P. New or little-known Tipulidæ from eastern Asia (Diptera), XLIV	27
STIASNY, G. Octocorallia from Philippine waters	67
BOOKS	75

The articles in the Philippine Journal of Science are indexed in the International Index to Periodicals, New York, N. Y.